ePORT, NASA's Computer Database Program for System Safety Risk Management Oversight (Electronic Project Online Risk Tool)

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Keywords

ePORT, Continuous Risk Management, NASA, MSFC, Program, Project

Abstract

ePORT (electronic Project Online Risk Tool) provides a systematic approach to using an electronic database program to manage a program/project risk management processes. This presentation will briefly cover the standard risk management procedures, then thoroughly cover NASA's Risk Management tool called ePORT. This electronic Project Online Risk Tool (ePORT) is a web-based risk management program that provides a common framework to capture and manage risks, independent of a programs/projects size and budget. It is used to thoroughly cover the risk management paradigm providing standardized evaluation criterion for common management reporting. ePORT improves Product Line, Center and Corporate Management insight, simplifies program/project manager reporting, and maintains an archive of data for historical reference (ref. 1).

Introduction

Proactive fundamental managing processes are essential in preventing potentially detrimental consequences. From a program's/project's (P/P) conceptual phase to its disposal, it is imperative that potential negative events are identified early to ensure appropriate mitigation processes are implemented to reduce or eliminate prospective negative impacts. It is imperative that since all P/P are dynamic; the Risk management (RM) process should therefore be fluid and continuously updated as the schedule progresses.

Disciplines, be they engineering, social, academia and the like all have unique Risk associated with them and can utilize a RM approach as they see fit. Therefore, the term program/project "P/P" encompasses all disciplines and is used as such during this discussion. In addition, though this paper discusses only ePORT, the RM practices for ePORT can be utilized in other programs as well.

At no time in the history of the human race has the pace of technology increased as it has these past one hundred years. As the technology development has increased exponentially, Risks associated with this shift has increased accordingly. Fortunately, commercially available computer programs exist today that can assist with the RM processes. This paper is designed to discuss one such program developed and utilized at the United States National Aeronautics and Space Administration (NASA) George C. Marshall Space Flight Center (MSFC) in Huntsville, Alabama. It is called ePORT for electronic Project Online Risk Tool. It is used extensively at NASA and is for internal use only, not for sale or deployment. However, the program serves as an example of how others might employ a similar tool in their RM work.

History

By early 2001, several independent studies were reporting insufficient RM practices at NASA (e.g., Faster, Better, Cheaper Task Force; Mars Climate Orbiter Mishap Investigation Board; NASA Integrated Action Team). MSFC Systems Management Office (SMO) reacted to the Agency's and Center's refocus on RM by meeting with MSFC Safety and Mission Assurance (S&MA) and P/P Risk managers across MSFC and at other NASA Centers to assess available RM tools. This assessment highlighted a general conclusion that no cost-effective, robust, cross-platform tools were available that fully met P/P needs. Because of this condition, larger initiatives would build their own database systems from scratch at significant cost while smaller initiatives struggled to effectively manage Risks due to the lack of funds. Since one of SMO's chartered functions was to "Direct the development of standard processes, tools, and guidelines for P/P management...," it was decided to add the RM Module to the ePORT requirements.

From July 2001 to November 2002, SMO worked with NASA Headquarters (HQ) and other NASA Centers to develop recommendations for the Agency Project Management Council (PMC) to establish a common approach for health status and Risk management reporting. In February 2002, SMO completed successful Operational Readiness Review of ePORT Core and made version 1.0 available to MSFC P/P (ref. 2).

Some key tenets to ePORT development were that the P/P Managers should own their assessments and be maintained at least one level lower than required by management to improve accuracy in reporting. Any common reporting criteria should be used where established.

ePORT allows the users to download reports in formats that can be easily incorporated into standard applications [portable document format (.PDF) or Microsoft Excel (.xls)]. The tool provides benefits to P/P, not just upper management, and allows managers as much flexibility as possible for data organization and access control, see Figure – 1 (ref. 3).
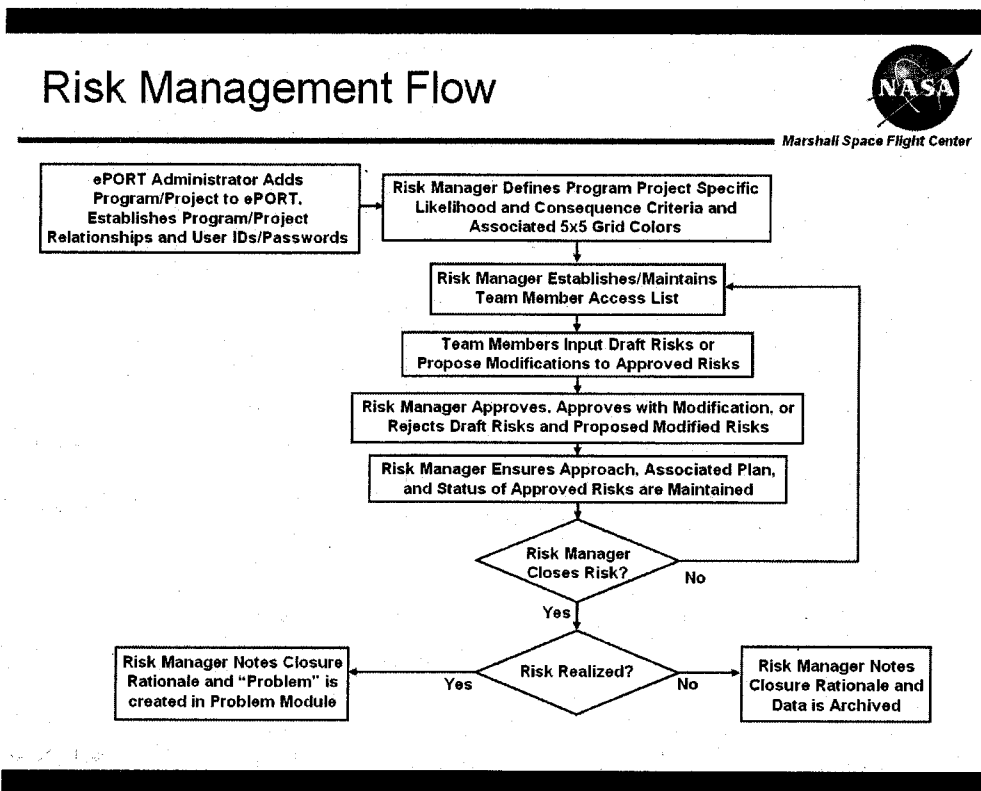
Risk Management Flow

Marshall Space Flight Center

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ePORT Administrator Adds          Risk Manager Defines Program Project Specific
Program/Project to ePORT.     →      Likelihood and Consequence Criteria and
Establishes Program/Project                Associated 5x5 Grid Colors
Relationships and User IDs/Passwords

                                  Risk Manager Establishes/Maintains
                                       Team Member Access List

                                   Team Members Input Draft Risks or
                                  Propose Modifications to Approved Risks

                              Risk Manager Approves. Approves with Modification, or
                              Rejects Draft Risks and Proposed Modified Risks

                               Risk Manager Ensures Approach, Associated Plan,
                                 and Status of Approved Risks are Maintained

                                          Risk Manager
                                          Closes Risk?          No

                                             Yes

Risk Manager Notes Closure                  Risk Realized?              Risk Manager Notes
Rationale and "Problem" is      Yes                          No         Closure Rationale and
created in Problem Module                                               Data is Archived
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Figure – 1, ePORT Risk Management Flow

Continuous Risk Management Process

Before describing the ePORT program, a brief explanation of the RM process is in order. Continuous Risk Management (CRM) is a practice with processes, methods, and tools for managing Risks in a P/P. CRM as discussed in this paper for ePORT is based largely on the CRM process developed by the Carnegie Mellon University Software Engineering Institute (ref. 4) and provides a disciplined environment for proactive decision-making to access continuously what could go wrong (Risks), determine what Risks are important to deal with, and implement strategies to deal with those Risks. A simple RM paradigm is shown in Figure – 2. A thorough and more informative breakdown of the Continuous Risk Management Process Flow is seen in Figure – 3 (ref. 5).
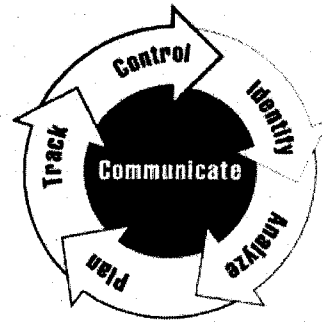
Figure – 2, Risk Management Paradigm
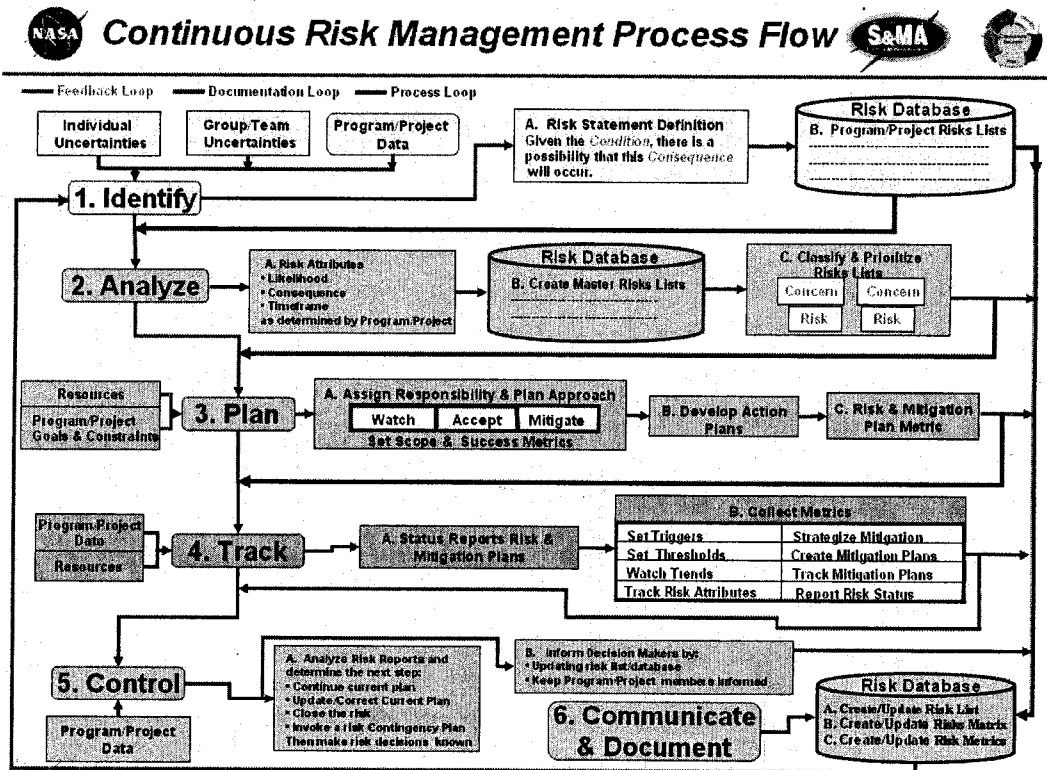
Figure – 3, Continuous Risk Management Process Flow

As indicated in the CRM Process Flow chart above, the six steps to a thorough CRM process begins with Identify and progresses through Analyze, Plan, Track, Control, and Communicate and Document:

Identify: Beginning with *Identify*, where the P/P considers Risks before they become a Problem. Anyone in a P/P can *Identify* Risks because each individual has particular knowledge about various parts of a P/P. During *Identify*, uncertainties and issues about the P/P are transformed into distinct (tangible) Risks that can be described and measured. The aim for the Risk statement is that it be clear, concise, and sufficiently informative so that the Risk is easily understood. The Risk statement should follow the following standard two part format:

Risk Statement: given the <condition> there is a possibility that <consequence> will occur (ref. 6)

Analyze: The purpose of *Analyze* is to convert the data into decision-making information. *Analyze* is a process of examining the Risks in detail to determine the extent of the Risks, how they relate to each other, and which ones are the most important. *Analyzing* Risks has three basic activities: *Evaluating* the attributes of the Risks (impact, probability, and timeframe), *Classifying* the Risks, and *Prioritizing* (ranking) the Risks.

Evaluating: The first step provides better understanding of the Risk by qualifying the expected impact, probability, and timeframe of a Risk. This involves establishing values for: *Probability*: The likelihood the Risk will occur; *Impact*: The loss or negative affect (consequence) on the P/P should the Risk occur; and *Timeframe*: The period when you must take action in order to mitigate the Risk.

Classifying: The second step allow placing each Risk in decision making corresponding fields. This enables the P/P to group identified Risks in specified disciplines so the Risk is assigned to the appropriate personnel.

Prioritizing: In *Prioritizing* Risks, the P/P can evaluate the Risks that pose the highest concern. Here the amount of effort and/or time when to begin actions to work on the Risk is decided.

Figure – 4 demonstrates Sample Attribute Values that might be used to evaluate Risks (ref. 7).
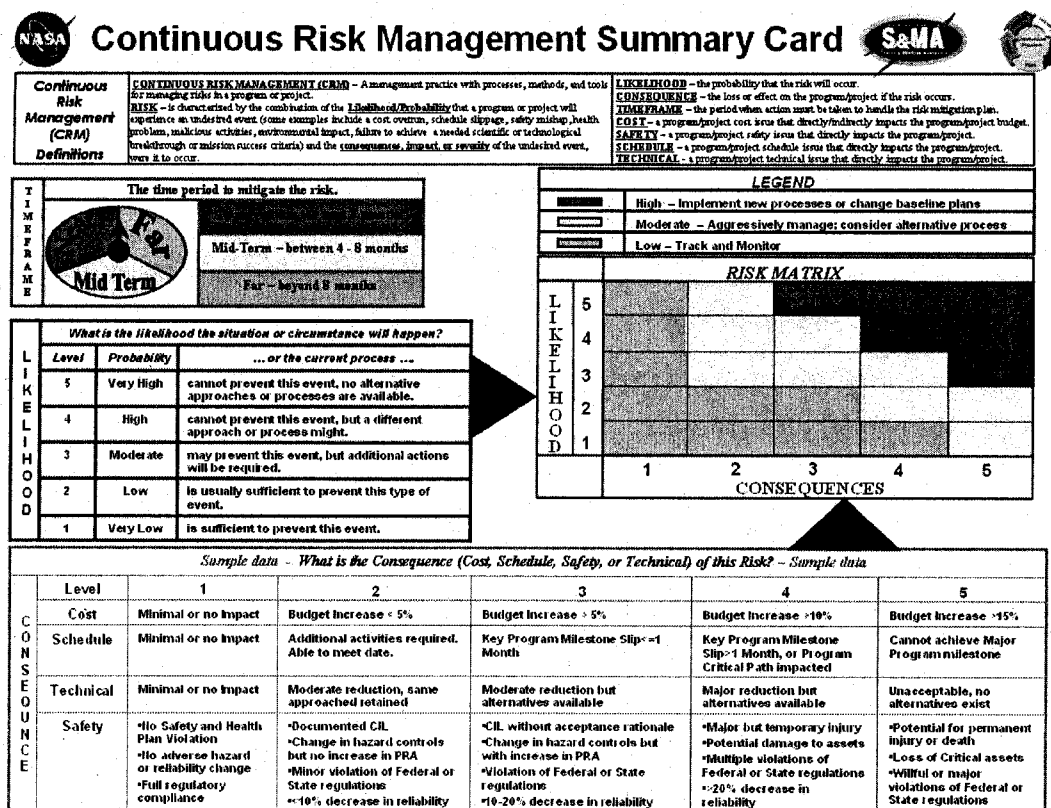

Figure – 4, Sample Attribute Values

Plan: *Planning* is the function of deciding what, if anything should be done about a Risk or set of related Risks. In this function, decisions and mitigation strategies are developed based on current knowledge of P/P Risks.

The purpose of *Plan* is to: Make sure the consequences and the sources of the Risk are known; Develop effective *Plans*; *Plan* efficiently (only as much as needed or will be of benefit); produce, over time, the correct set of actions that minimize the impacts of Risks (cost and schedule) while maximizing opportunity and value; and, *Plan* important Risks first.

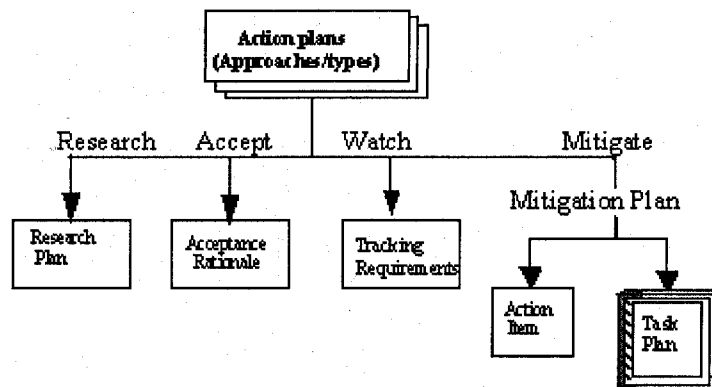Figure – 5 indicates the potential approaches to Risk *Planning*.

Figure – 5, Planning approaches

There are four options to consider when planning for Risks: (1) *Research:* establish a plan to research the Risk(s); (2) *Accept:* decide to "accept" the Risk(s) and document the rationale behind the decision; (3) *Watch:* monitor Risk conditions for any indications of change in probability or impact (tracking metrics must be established and documented); and (4) *Mitigate:* allocate resources and assign actions in order to reduce the probability or potential impact of Risks. This can range from simple tasking to sweeping activities: (a) *Action Items:* a series of discrete tasks to mitigate Risk and (b) *Task Plan:* formal, well-documented and larger in scope (ref. 8).

Track: *Tracking* is the process by which Risk status data are acquired, compiled, and reported. The purpose of *Track* is to collect accurate, timely, and relevant Risk information and to present it in a clear and easily understood manner to the appropriate people/group. *Tracking* is done by the Risk owner who is responsible for monitoring "watched" or "mitigated" Risks. *Tracking* status information become critical to performing the next function in the Continuous Risk Management paradigm, i.e. Control. Supporting information, such as schedule and budget variances, critical path changes, and project/performance indicators can be used as triggers, thresholds, and Risk - or plan-specific measures where appropriate.

Example-1: A program metric might look at the rate of module completion. If this metric indicates that the rate of completion is lower than expected, then a schedule Risk should be identified (ref. 9).

Example-2: A program may set upper and lower boundaries as the limiting factors which can establish a false sense that all is going well when it actually may not be. For example, if the trends are stabilized near the upper boundary and they begin to fall, concern that a Problem might occur may not be flagged until the lower boundary is passed. At this point it may be too late. However, by monitoring the rate of change and understanding why the rapidly increasing rate of change is occurring the P/P can take appropriate action to prevent a problem from taking place.

Control: The purpose of the *Control* function is to make informed, timely, and effective decisions regarding Risks and their mitigation plans. It is the process that takes in tracking status information and decides exactly what to do based on the reported data. *Controlling* Risks involves analyzing the status reports, deciding how to proceed, and then implementing those decisions.

Decision makers need to know: (1) when or whether there is a significant change in Risk attributes and (2) the effectiveness of mitigation plans within the context of P/P needs and constraints.

The goal is to obtain a clear understanding of the current status of each Risk and mitigation plan relative to the P/P and then to make decisions based on that understanding. Tracking data is used to ensure that P/P Risks continue to be managed effectively and to determine how to proceed with P/P Risks. Options include: *Replan, Close the Risk, Invoke a Contingency Plan,* and *Continue Tracking and Executing the Current Plan*:

Replan: A new or modified plan is required when the threshold value has been exceeded, analysis of the indicators shows that the action plan is not working, or an unexpected adverse trend is discovered.
Close the Risk: A *Closed* Risk is one that no longer exists, has been overcome by events, or the Risk has become a *Problem*. When it becomes a *Problem* the event has occurred and it is now placed in a different category and is now tracked (see *Problem* section below).
Invoke a Contingency Plan: A *Contingency Plan* is invoked when a trigger has been exceeded or some other related action needs to be taken.
Continue tracking and executing the current plan: No additional action is taken when analysis of the tracking data indicates that all is going as expected or P/P personnel decide to continue tracking the Risk or mitigation plan as before. However, don't forget about the rate of change example mentioned earlier (ref. 10).

Communication and Documentation: The purpose of *Communicate and Document* is for *ALL* personnel to understand the P/P Risks, mitigation alternatives as well as Risk data and to make effective choices within the constraints of the P/P. *Communication and Documentation* are essential to the success of all other functions within the paradigm and are critical for managing Risks.

For effective Risk management, an organization must have open *Communication* and formal *Documentation. Communication* of Risk information is often difficult because the concept of Risk comprises two subjects that people don't normally deal well with: probability and negative consequences. *Documentation* allows for the necessary paper (electronic) tracking capability for current P/P actions, simplifies P/P manager reporting, and maintains an archive of data for historical reference.

Not only is effective Continuous Risk Management in jeopardy, but the P/P as a whole is in jeopardy when the environment is not based on open *Communication.* No one has better insight into Risks than P/P personnel, and *management needs that input.* Experienced managers know that the free flow of information can make or break any P/P. Open *Communication* requires: Encouraging free-flowing information at and between all P/P levels; enabling formal, informal and impromptu communication; and using consensus-based processes that value the individual voice, bringing unique knowledge and insight to identifying and managing Risks (ref. 11).

Phase-1: Where to begin

In an ideal case study, before a P/P initiates an electronic RM system such as in this case ePORT, it is imperative that the essential P/P disciplines have been identified and personnel manning these disciplines are in place. Equally important is that the P/P be in its early stages of development. This will ensure the P/P will be heading in the most efficient direction from the beginning. Once the team is in place, the P/P manager would need to set aside a mandatory two day (minimum) off-site stand down for RM training for ALL personnel assigned to the P/P. This effort will ensure all team members are properly and thoroughly educated in the RM process equally and to relay any P/P updates prior to identifying P/P Risks. In addition, since ePORT will be utilized throughout the training, it is imperative that all team members attend regardless if they are familiar with the RM processes because they will be creating their personal accounts, taught how to navigate through ePORT, and learn how to input Risks. For efficiency purposes, an ePORT administrator should also be identified, present at the training session, be well trained in ePORT beforehand, and be the designated P/P ePORT central point of contact. Each team member will begin to use the RM paradigm and correctly identify and state Risks as they are imputed into the ePORT system. The beauty of this process is three fold, at the end of the training all team members are equally knowledgeable of the RM process, they will know how to independently submit Risks in their areas of expertise at any stage in the P/P life cycle (thus the term "Continuous" RM), and the P/P has established a team building event in the process.

Once the P/P team members complete the training course they will become experts in the RM process. Access to ePORT is limited to the P/P Manager or personnel designated as their representatives for either data entry or review. Each initiative is partitioned from the others to only allow access to approved members of the team or upper management. It is best that the users and Risk managers initiate access based on their P/P responsibilities. Clicking on the system requirements link takes the user to a new page detailing ePORT's system requirements and provides access to the latest version of software needed to view ePORT as well as some optional plug-ins.

ePORT System Requirements: ePORT was developed so that users would not be required to acquire special proprietary software except for normal freeware multimedia plug-ins in order to use the tool. The development team has a continuous objective to ensure the tool is platform independent. ePORT is designed to work consistently on PC and Macintosh platforms using Internet Explorer or Safari. While ePORT may work with older or newer versions of the software specified, it was designed and tested using the versions listed (ref. 12).

Platform	Browser
MacIntosh	Safari
Windows 2000, 2003, XP Internet	Explorer
Additional Plug-ins	Adobe Reader

The home page for ePORT has a primary main menu that is divided into seven major sections: Message Center, Profile, Risk, Problems, Reports, Help, Setup and Sign out. When selecting any one of these sections, sublinks are generated for specific areas of CRM operations for the P/P team members to use and are described below.

Message Center: Returns the user to the initial main screen to view administrative messages pertaining to ePORT for the P/P users. As the P/P progresses, noted RM information that needs to be disseminated to the team is shown here.

Profile: Links to a one-screen synopsis of the P/P containing Initiative Name (P/P name), the NASA Center for the P/P, Initiative Hierarchy of the P/P, and points of contact (names, phone numbers, email addresses) which are listed alphabetically.

Risks: Contains tools for managing the initiative on a continual basis. By selecting **[Risks]**, users gain access to a complete RM database to plan strategies for recognizing and mitigating potential threats to the initiative's success. Sub links include Add, Index, Status, 5x5 Grid, and Definitions:

o *Add:* Contains the necessary blank fields for filling in each Risk. Red asterisk areas are mandatory fields before submitting and include Likelihood, Consequence (Cost, Schedule, Performance and Safety) all 1 to 5, Title, Statement, Team, Owner, Timeframe (Near Mid and Far), Approach (Research, Mitigation, Watch, Accept). Additional blank fields include Planned Closure Date, Context, Research Plan, Mitigation Plan, Watch Plan/Tracking Requirements, Management Plan and Status. One note here is to be careful when referencing web links, without any notice the link itself or sub-links within it could be deleted or worst case the information is outdated, incorrect and may lead you down the wrong path. It is best to refrain from using web links in any Risk statements, subsequent data, or in documentation.

o *Index:* Is the page where the user can identify specific areas when performing selected criteria. It is basically a bean counter for the P/P. Here displays of the summary of all Risks by criticality are shown and it allows for P/P Risk integration and multiple ways to sort specific Risks. The user can draft Risks tailored reports from Approved Risks and Proposed Modifications (Mods) and automatically flag identity when proposed Mods exist. For example, if management wishes to have listed only Status (Open), Criticality (Medium), Timeframe, (Near), Approach (Accept, Research and Mitigate) only Risks, they only need to choose the said criteria and select **[Search]**. One can even choose the specified Risks via Owner, Teams, Category, Group and sort the list via Descending, Ascending or RID (Risk Identification Number).

o *Status:* After selecting **[Search]** from the Index page, a list of the requested Risk appears. By selecting **[Status]**, this list will now appear in criticality hierarchy previously selected in the *Index* page with each Risk having its designated Risk Plan and Approach shown.

o *5x5 Grid*:   Shows where all approved Risked previously identified in the *Likelihood* versus *Consequences* 5x5 matrix grid, see Figure – 6 (ref. 13). After all the Risks have been accepted by the Risk board or management board they are formally entered into the ePORT. At this time a Risk 5x5 Summary Matrix can be generated. The data from this matrix allows the severity of the Risk of an event occurring to be determined. Here the P/P can designate which list to monitor (i.e. top 10) and prioritize the immediate effort to work the more severe Risks first or Risks that can be mitigated the quickest, however the P/P chooses. ePORT uses the following criteria to rank Risks: (1) by criticality (High, Med, and Low); (2) by worst-case LxC (Likelihood x Consequence) product; (3) by composite LxC (sum of each LxC product for cost, schedule, technical and safety consequence); (4) by timeframe (near, mid, far); (5) by approach (mitigate, research, watch, and accept); and (6) by Risk identification number.

o *Definitions*: Through a pop-up page, the P/P selected Risk Definitions are defined (Timeframe – Near, Mid and Far) (Likelihood and Consequences – Cost, Schedule, Performance, Safety, etc.) (Risk Values – 5, 4, 3, 2 and 1). These definitions are also shown in Figure – 4 above.
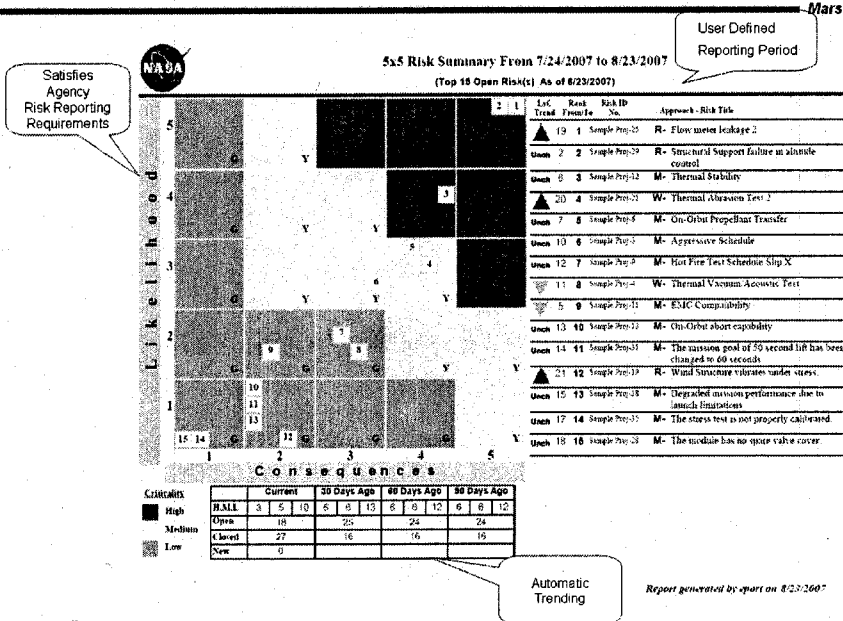

Figure – 6, ePort Risk 5x5 Summary Grid

Problems: Contains tools for managing the Problems that are associated with an initiative on a continual basis. By selecting **[Problems]**, users gain access to a complete Problems management database to plan strategies for handling the initiative's ongoing Problems. A special note here is that when a Risk becomes a Problem, the event has occurred and is therefore moved within ePORT and tracked separately. As with the *Risks* link noted above, *Problems* also has *Add, Index, Status, and Definitions*. However, in addition *Problems* has *Summary* and *Issues* links.

o *Summary*: Lists the Impact Summary in a 3x3 grid relative to the noted *Problem's* impact in Red (high Criticality), Yellow (Medium Criticality) and Green (Low Criticality) versus the timeframes Near, Mid and Far.

o *Issues*: Lists both the noted 3x3 grid in *Summary* and the 5x5 (Likelihood versus Consequences) Grids for *Problems*.

Reports: Allow the user to select specific data and templates to create tailored reports for the accepted Risks, Problems and General where the user can select the ability to download the information in either portable document format (.PDF) or Microsoft Excel (.xls).

Help: Contains immediate resources to aid the user in using ePORT. By selecting **[User Guide]**, a new web browser window will open and provide access to a web based help guide. By selecting **[FAQ]**, the user can view the most frequently asked questions along with their answer or submit their own question. By selecting **[Comments/Questions]**, the user can view comments and responses entered to date and submit comments, questions or bugs to the administrator.

Setup: Houses all user-defined preferences that are available to task manager, Risk manager or the general users. Users have access to their own user preferences by selecting **[My Preferences]**. The **[Risk Admin]** section allows the Risk manager to establish the Risk settings for their initiative.

Sign out: It is a must to always **[Sign Out]** of ePORT after each session to maintain integrity of the user's initiatives data. If the user's browser stays idle for more than 20 minutes the user's session will time out and the user will be automatically asked to log back in (ref. 14).

Conclusion

In any system the RM process works in maintaining a P/P ability to stay on schedule and within budget. The difficulty lies in actually implementing a thorough RM process. Often a P/P Risk Management Plan (RMP) is hastily written and then thrown in a corner to gather dust until a Problem occurs. Having a thoroughly trained staff and a computer based centralized RM program in place is not only essential but imperative for any P/P. In addition to the RM course, one of the steps NASA has taken is to establish a Risk management web site that contains sample Risk management plans and a schedule of classes. A significant amount of time was spent discussing with managers the benefits of taking a formal training course where the costs and time spent is more than recovered by a P/P when all team members are working toward common goals in a coordinated manner. In doing so ePORT has proven itself over and over as a P/P viable and necessary tool by improving the product line, Center and Corporate management insight, simplifying P/P manager reporting processes, and maintaining an archive of data for historical reference.

With the current United States space initiative directive, completing the International Space Station and traveling back to the Moon and then to Mars, new technical challenges are being encountered each day. NASA has been a leader in the aerospace industry; however, this industry is rapidly changing. High tech private adventures are cropping up every day and with the proper tools in place they can succeed. There are several commercially available RM tools on the market. A proactive manager of any P/P should ensure their teams master these tools. The positive result will show when they deliver products and or services that are on time, safe, reliable and profitable.

References

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Biography

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Abbreviations and Acronyms

Admin	Administration
CRM	Continuous Risk Management
ECLSS	Environmental Control and Life Support Systems
EPA	Environmental Protection Agency
ePORT	Electronic Project Online Risk Tool
F	Far-term
FAQ	Frequently Asked Questions
GSE	Ground Support Equipment
H	High
HQ	Headquarters
ISS	International Space Station
L	Low
LxC	Likelihood x Consequence
M	Medium
M	Mid-term
Mod	Modification
MSFC	Marshall Space Flight Center
N	Near-term
NASA	National Aeronautics and Space Administration
OSHA	Occupational Safety and Health Act
.PDF	Portable Document Format®
P/P	Program and/or Project
PMC	Program Management Council
RID	Risk Identification Number
RM	Risk Management
S&MA	Safety and Mission Assurance
SMO	Systems Management Office
UAF	User Access Form
.xls	Microsoft Excel®

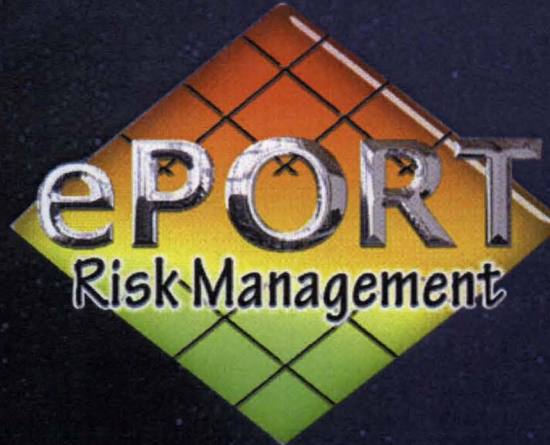International System Safety Regional Conference 2008

Paul Johnson

National Aeronautics and Space Administration
George C. Marshall Space Flight Center

NASA's Computer Database Program for System Safety Risk Management Oversight

HANDOUTS

- **CRM Process Flow**
- **CRM Summary Card**
- **CRM Paradigm**
- **CRM Program/Project Risk Definitions**
- **CRM Training Processes and Solutions tri-fold**

Saturn V

Space
Shuttle

Ares I

Ares V

363 ft
110 m

400

300

200

Feet

100

0

Launch Escape System (LES)

Launch Abort System (LAS)
Orion

Ares I

	Saturn V	Space Shuttle	Ares I	Ares V
Weight:	6.50 MP = 28.91 MN	4.50 MP = 20.02 MN	2.04 MP = 9.07 MN	7.40 MP = 32.92 MN
Thrust:	7.50 MP = 33.36 MN	6.42 MP = 28.57 MN	3.50 MP = 15.57 MN	10.25 MP = 45.59 MN
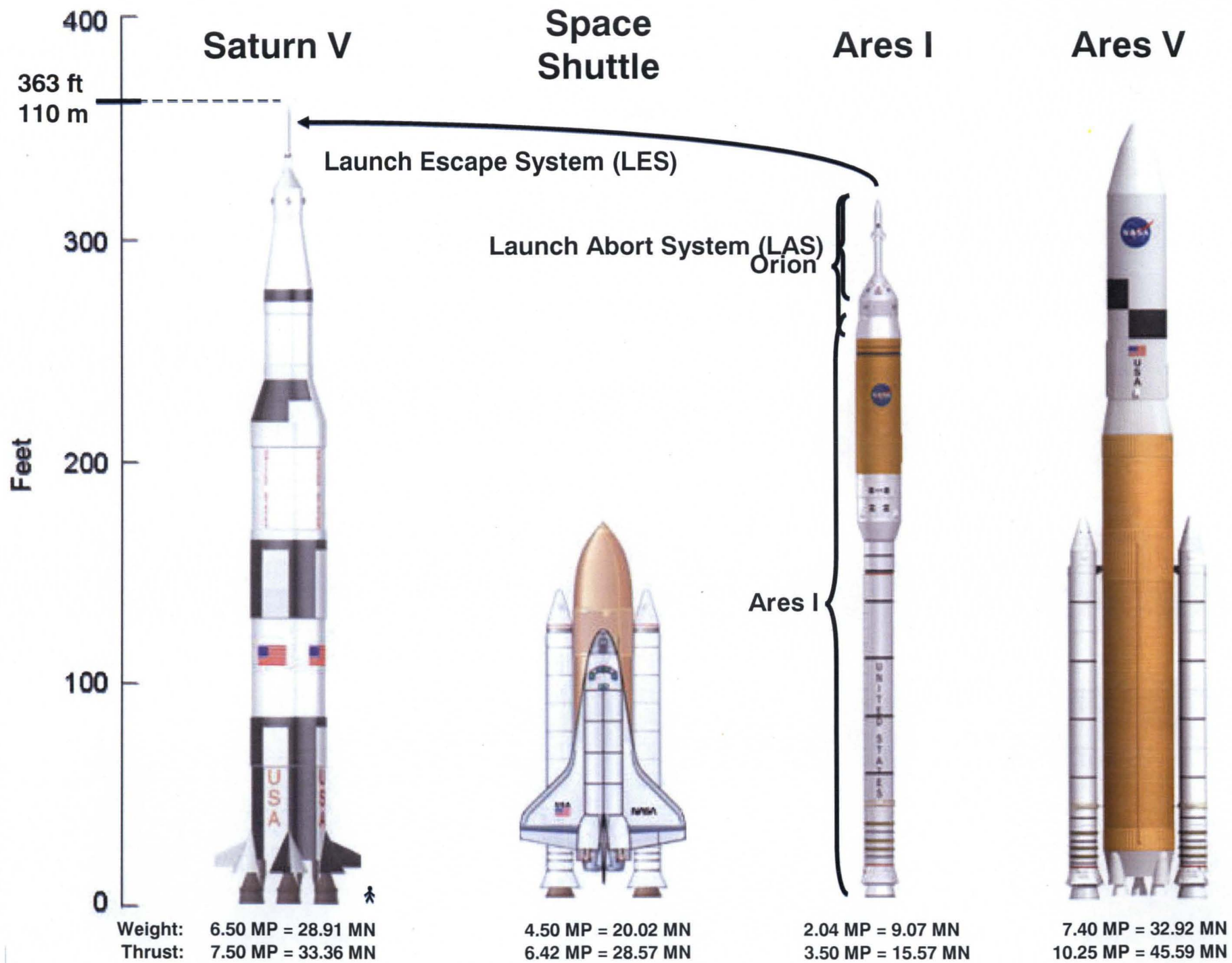
Apollo Launch Escape System (LES)

Aries I Launch Abort System (LAS)

Orion

Launch Abort System (LAS)

Jettison Motor (JM) Static Firing Test

27 Mar 08

AGENDA

◆ **Quote**

◆ **ePORT History**

◆ **Continuous Risk Management Process**

◆ **ePORT - Project: PILOT**

◆ **Things To Think About**

◆ **Q&A**

QUOTE

"Proactive fundamental managing processes are essential in preventing potentially detrimental consequences."

ePORT HISTORY

◆ **Independent Studies showed insufficient Risk Management (RM) practices at NASA for Programs/Projects (P/P).**

◆ **No cost-effective, robust, cross-platform RM tools were available that fully met P/P needs:**

- to each his own.

◆ **Direction to develop standard processes, tools and guidelines for P/P management.**

◆ **ePORT – electronic Project Online Risk Tool**

DEFINITIONS

◆ **What is Continuous Risk Management:**

- It is a <u>continuous</u> iterative process to manage risks in order to achieve mission success.

◆ **What is a RISK:**

- It is characterized by the <u>combination</u> of the "probability" that the Program/Project will experience an undesired event (cost, schedule, safety or technical) and the "consequences, impact, or severity" of the undesired event, were to occur.

NOT ALL INCLUSIVE!

Cost   Schedule   Safety   Technical

- Development, Level of Technology Readiness, Work Breakdown Structure (WBS), Refunding Profile, Manpower Availability, etc...

- Initial Design Review (IDR), Preliminary Design Review (PDR), Material Readiness Review (MRR), Critical Design Review (CDR), Manufacturing Due Dates, Delivery Dates, etc...

- Hazard Analysis, Failure Modes and Effects Analysis (FMEA), Critical Item List (CIL), Reliability Requirements, Redundancy Requirements (Fault Tolerance), Industrial Safety, etc...

- Anomalies, Testing, Manufacturing, Quality Control, Design, Material Availability, Personnel Expertise, etc...

Cost Schedule Safety Technical

Development, Level of Technology Readiness, Work Breakdown Structure (WBS), Refunding Profile, Manpower Availability Initial Design Review (IDR), Preliminary Design Review (PDR), Material Readiness Review (MRR), Critical Design Review (CDR), Manufacturing Due Dates, Delivery Dates, - Hazard Analysis, Failure Modes and Effects Analysis (FMEA), Critical Item List (CIL), Reliability Requirements, Redundancy Requirements (Fault Tolerance) Industrial Safety, Anomalies (Testing, Manufacturing, Quality Control), Design, Material Availability, Personnel Expertise, etc…

Cost   Schedule   Safety   Technical

Development, Level of Technology Readiness, Work Breakdown Structure (WBS), Refunding Profile, Manpower Availability Initial Design Review (IDR), Preliminary Design Review (PDR), Material Readiness Review (MRR), 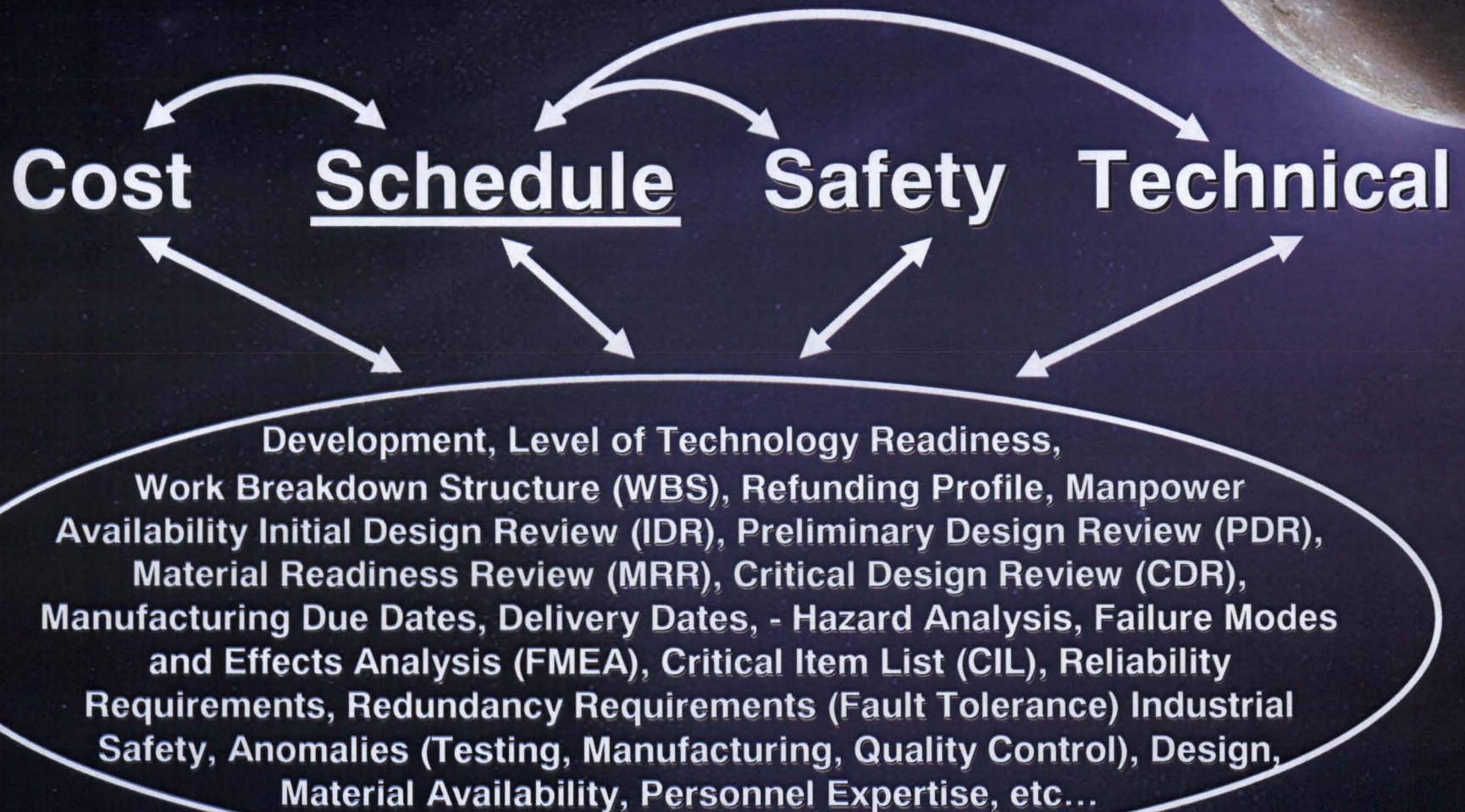Critical Design Review (CDR), Manufacturing Due Dates, Delivery Dates, - Hazard Analysis, Failure Modes and Effects Analysis (FMEA), Critical Item List (CIL), Reliability Requirements, Redundancy Requirements (Fault Tolerance) Industrial Safety, Anomalies (Testing, Manufacturing, Quality Control), Design, Material Availability, Personnel Expertise, etc…

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PILOT

- ▣ **Message Center**
- ▣ **Profile**
- ▣ **Risks**
- ▣ **Problems**
- ▣ **Reports**
- ▣ **Help**
- ▣ **Setup**
  - ▣ **My Preferences**
  - ▣ **Initiative Mgr**
    - ▣ **Members**
    - ▣ ☑ **Grp/Tms/Cat**
    - ▣ **Messages**
    - ▣ **Risk Defin**
    - ▣ **Problem Defin**
    - ▣ **Risk Transfer**
    - ▣ **Manage Init**
- ▣ **Sign Out**

Groups, Teams And Categories for PILOT

Groups	Teams	Categories
[_____] Add	[_____] Add	[_____] Add

Click on the Group, Team or Category Name to delete it from the initiative.

Everyone	Engineering	Drawings
	Management	Electrical
	S&MA	Materials
	Testing	Quality
		Reliability
		Risk Manager
		Safety
		Schedule
		Setup
		Thermal

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- ◘ **Message Center**
- ◘ **Profile**
- ⊞ **Risks**
- ⊞ **Problems**
- ⊞ **Reports**
- ⊞ **Help**
- ◘ **Setup**
  - ◘ **My Preferences**
  - ◘ **Initiative Mgr**
    - ◘ ☑ **Members**
    - ◘ **Grp/Tms/Cat**
    - ◘ **Messages**
    - ◘ **Risk Defin**
    - ◘ **Problem Defin**
    - ◘ **Risk Transfer**
    - ◘ **Manage Init**
- ◘ **Sign Out**

Member Access for PILOT

1) Select User to add to your team

Select User to add to your Inititative ⌄

2) Click on name to update the access level of the team member and to see the delete option.

Member	Team Role	Notify?	Groups
Coker, Cynthia	Team Member	No eMAIL	Everyone
Grubbs, Rodney	Team Member	No eMAIL	Everyone
Haynes, Michael	Team Member	No eMAIL	Everyone
Hoffman, R.	Team Member	No eMAIL	Everyone
Johnson, Paul	Risk Manager	eMAIL	Everyone
Kulpa, Vygantas	Team Member	No eMAIL	Everyone
Moore-Hartley, Pat	Team Member	No eMAIL	Everyone
Morgan, Markeeva	Team Member	No eMAIL	Everyone
Mullane, Dan	Team Member	No eMAIL	Everyone
Powell, William	Team Member	No eMAIL	Everyone
Spurgeon, Jennifer	Team Member	No eMAIL	Everyone
Suttle, Madelyn	Team Member	No eMAIL	Everyone
Wise, Angela	Team Member	No eMAIL	Everyone
Wrigley, Tracy	Team Member	No eMAIL	Everyone

Continuous Risk Management Summary Card

NASA · S&MA

Continuous Risk Management (CRM) Definitions

CONTINUOUS RISK MANAGEMENT (CRM) – A management practice with processes, methods, and tools for managing risks in a program or project.

RISK – is characterized by the combination of the **Likelihood/Probability** that a program or project will experience an undesired event (some examples include a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technological breakthrough or mission success criteria) and the **consequences, impact, or severity** of the undesired event, were it to occur.

LIKELIHOOD – the probability that the risk will occur.
CONSEQUENCE – the loss or effect on the program/project if the risk occurs.
TIMEFRAME – the period when action must be taken to handle the risk mitigation plan.
COST – a program/project cost issue that directly/indirectly impacts the program/project budget.
SAFETY – a program/project safety issue that directly impacts the program/project.
SCHEDULE – a program/project schedule issue that directly impacts the program/project.
TECHNICAL - a program/project technical issue that directly impacts the program/project.

TIMEFRAME

The time period to mitigate the risk.

Near / Far / Mid Term

Near – within the next 3 months	
Mid-Term – between 4 - 8 months	
Far – beyond 8 months	

LIKELIHOOD

What is the likelihood the situation or circumstance will happen?

Level	Probability	... or the current process ...
5	Very High	cannot prevent this event, no alternative approaches or processes are available.
4	High	cannot prevent this event, but a different approach or process might.
3	Moderate	may prevent this event, but additional actions will be required.
2	Low	is usually sufficient to prevent this type of event.
1	Very Low	is sufficient to prevent this event.

LEGEND

🟥	**High** – Implement new processes or change baseline plans
🟨	**Moderate** – Aggressively manage; consider alternative process
🟩	**Low** – Track and Monitor

RISK MATRIX

LIKELIHOOD (5, 4, 3, 2, 1) vs CONSEQUENCES (1, 2, 3, 4, 5)

CONSEQUENCE

Sample data - What is the Consequence (Cost, Schedule, Safety, or Technical) of this Risk? – Sample data

Level	1	2	3	4	5
Cost	Minimal or no Impact	Budget Increase < 5%	Budget Increase > 5%	Budget Increase >10%	Budget Increase >15%
Schedule	Minimal or no Impact	Additional activities required. Able to meet date.	Key Program Milestone Slip<=1 Month	Key Program Milestone Slip>1 Month, or Program Critical Path impacted	Cannot achieve Major Program milestone
Technical	Minimal or no Impact	Moderate reduction, same approached retained	Moderate reduction but alternatives available	Major reduction but alternatives available	Unacceptable, no alternatives exist
Safety	•No Safety and Health Plan Violation •No adverse hazard or reliability change •Full regulatory compliance	•Documented CIL •Change in hazard controls but no increase in PRA •Minor violation of Federal or State regulations •<10% decrease in reliability	•CIL without acceptance rationale •Change in hazard controls but with increase in PRA •Violation of Federal or State regulations •10-20% decrease in reliability	•Major but temporary injury •Potential damage to assets •Multiple violations of Federal or State regulations •>20% decrease in reliability	•Potential for permanent injury or death •Loss of Critical assets •Willful or major violations of Federal or State regulations

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PILOT ⌄

- ⊞ Message Center
- ⊞ Profile
- ⊞ Risks
- ⊞ Problems
- ⊞ Reports
- ⊞ Help
- ⊟ Setup
  - ⊞ My Preferences
  - ⊟ Initiative Mgr
    - ⊞ Members
    - ⊞ Grp/Tms/Cat
    - ⊞ Messages
    - ⊞ ☑ Risk Defin
    - ⊞ Problem Defin
    - ⊞ Risk Transfer
    - ⊞ Manage Init
- ⊞ Sign Out

Risk Definitions for PILOT

Commercially available CRM programs may charge extra for this process!

Time Frame Definitions   [Update]

Near
> The project must take action on the identified risk or the project will be impacted by the risk in the next 90 days.

Mid
> The project must take action on the identified risk or the project will be impacted by the risk in the next 90-180 days.

Far
> The project need not take action for at least the next 180 days -any impact will occur in > 180 days.

Likelihood and Consequences Definitions   [Update]

	Likelihood		Consequences	
	All Types	Cost	Schedule	Performance
Risk Value	Your team's current process . . .	Given the event occurs, what magnitude (consequence level) of the imp		
1	Qualitative: Occurrence improbable. Quantitative: P <= 10-6 for risks with primary	<= 2 percent Negligible impact to budget	Negligible Schedule Impact	Negligible impact to requirements, mission objectives or technical goals

Near

Mid

The project must take action on the identified risk or the project will be impacted by the risk in the next 90-180 days.

Far

The project need not take action for at least the next 180 days -any impact will occur in > 180 days.

[Update]

Likelihood and Consequences Definitions

	Likelihood	Consequences			
	All Types	Cost	Schedule	Performance	Safety
Risk Value	Your team's current process . . .	Given the event occurs, what magnitude (consequence level) of the impact to your team?			
1	Qualitative: Occurrence improbable. Quantitative: P <= 10-6 for risks with primary impact on Human Safety. P <=	<= 2 percent Negligible impact to budget	Negligible Schedule Impact	Negligible impact to requirements, mission objectives or technical goals	Human Safety - A condition that could cause the need for minor first aid treatment though would not adversely affect
2	Qualitative: Unlikely to occur. Quantitative: 10-6 < P <=10-3 for risks with primary impact on Human Safety. 1 percent <	> 2 percent but <=5 percent Minor impact to budget	Minor Overall Schedule Impact Accommodate with reserve, no impact to critical path	Minor Impact to requirements, mission objectives or technical goals	Human Safety - A condition that may cause minor injury or occupational illness. Class III
3	Qualitative: May occur. Quantitative: 10-3 < P <= 10-2 for risks with primary impact on Human Safety. 10 percent <	> 5 percent but <=10 percent Moderate impact to budget	<= 1 month impact to critical path / milestones	Moderate impact to requirements, mission objectives or technical goals	Human Safety - A condition that may cause severe injury or occupational illness. Class II
4	Qualitative: Probably will occur. Quantitative: 10-2 < P <=10-1 for risks with primary impact on Human Safety. 33	> 10 percent but <= 15 percent Major impact to budget	>1 and ≤6 month impact to critical path / milestones	Major impact to requirements, mission objectives or technical goals	Human Safety - A condition that may cause permanently disabling injury. Class I D
5	Qualitative: Likely to occur. Quantitative: P >10-1 for risks with primary impact on Human Safety. P >50 percent for risks	> 15 percent Possible program cancellation	>6 month impact to critical path / milestones or possible program/project cancellation	Performance goals not achievable with existing engineering capabilities / technologies	Human Safety - A condition that may cause death or loss of crew. Class I A

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PILOT

- Message Center
- Profile
- Risks
- Problems
- Reports
- Help
- Setup
  - My Preferences
  - Initiative Mgr
    - Members
    - Grp/Tms/Cat
    - Messages
    - Risk Defin
    - ☑ Problem Defi
    - Risk Transfer
    - Manage Init
- Sign Out

Problem Definitions for PILOT

Time Frame Definitions   [Update]

Near
> The project must take action on the identified risk or the project will be impacted by the risk in the next 90 days.

Mid
> The project must take action on the identified risk or the project will be impacted by the risk in the next 90-180 days.

Far
> The project need not take action for at least the next 180 days (any impact will occur in greater than 180 days).

Impact Definitions   [Update]

	Impacts			
	Cost	**Schedule**	**Performance**	**Safety**
Value	The magnitude of the impact to your team?			
1	≤2% (Negligible impact to budget)	Negligible Schedule Impact	Negligible impact to requirements, mission objectives or technical goals	Human Safety - A condition that could cause the need for minor first aid treatment though would not adversely affect
	>2% but ≤5% (Minor impact to	Minor Overall Schedule Impact	Minor Impact to requirements,	Human Safety - A condition

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PILOT

- ▣ Message Center
- ▣ Profile
- ▣ Risks
  - ▣ ☑ Add
  - ▣ Index
  - ▣ Status
  - ▣ 5x5 Grid
  - ▣ Definitions
- ▣ Problems
- ▣ Reports
- ▣ Help
- ▣ Setup
- ▣ Sign Out

Risks For PILOT

[Definitions]

Risk Manager must add Teams before risks can be added!

Risk Information Sheet

* Indicates mandatory fields

☑ **Draft**

Planned Closure Date [____]

Likelihood*
◉1 ○2 ○3 ○4 ○5

Title*
[____]

Consequences*

Cost
◉1 ○2 ○3 ○4 ○5

Schedule
◉1 ○2 ○3 ○4 ○5

Statement*
[____]

Performance
◉1 ○2 ○3 ○4 ○5

Safety
◉1 ○2 ○3 ○4 ○5

Team *
[Select an Team ▾]

Owner*
[Select an Owner ▾]

Timeframe* ◉ Near ○ Mid ○ Far

Context
[____]

Approach* ◉ Research ○ Mitigation ○ Watch ○ Accent

RISK STATEMENT

Given the *<condition>*, there is a possibility that this *<consequence>* will occur.

RISK STATEMENT

Given the <failure of turbine blades at high RPMs can lead to turbine fragmentation>, there is a possibility <loss of containment> will occur.

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PILOT

- ■ Message Center
- ■ Profile
- ■ Risks
  - ■ Add
  - ■ ☑ Index
  - ■ Status
  - ■ 5x5 Grid
  - ■ Definitions
- ■ Problems
- ■ Reports
- ■ Help
- ■ Setup
- ■ Sign Out

Risks For PILOT

Current Version 2 Submitted on 4/14/2008 12:02:00 PM ⓚ ◀

Risk Information Sheet
PILOT-5

[Submit]

* Indicates mandatory fields

☐ Close   ☐ Draft

Planned Closure Date 2/15/2009

Likelihood *
○1 ◉2 ○3 ○4 ○5

Title *
High Pressure Oxygen Tubopump Turbine Blade Failure

Consequences *
Cost
○1 ○2 ○3 ◉4 ○5

Statement *
Given the failure of a turbine blade at high RPMs can lead to turbine fragmentation, there is a possibility of loss of containment will occur.

Schedule
○1 ○2 ○3 ◉4 ○5

Performance
○1 ○2 ○3 ◉4 ○5

Safety
○1 ○2 ◉3 ○4 ○5

Team *
Testing

Owner *
Spurgeon, Jennifer

Category
Setup

Timeframe * ○ Near ○ Mid ◉ Far

Context

Performance

○1 ○2 ○3 ◉4 ○5   containment will occur.

Safety

○1 ○2 ◉3 ○4 ○5

Team *   **Owner** *   **Category**

[Testing   ▾]   [Spurgeon, Jennifer ▾]   [Setup   ▾]

Timeframe * ○ Near   ○ Mid   ◉ Far

Context

Approach * ◉ Research   ○ Mitigation   ○ Watch   ○ Accept

Research Plan

Turbine airfoil durability analyses needs be be conducted to verify that the
airfoils have infinite life.

Management Plan

Status

Previous Status

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| PILOT ⌄ |

- ▪ **Message Center**
- ▪ **Profile**
- ▪ **Risks**
  - ▪ Add
  - ▪ ☑ Index
  - ▪ Status
  - ▪ 5x5 Grid
  - ▪ Definitions
- ▪ **Problems**
- ▪ **Reports**
- ▪ **Help**
- ▪ **Setup**
- ▪ **Sign Out**

Risks For PILOT

H (2)   **M** (5)   **L** (1)

[Hide Search]

1) Select Initiative(s):   **2) Select the Criteria:**   ☐ **Set As Default Criteria**

| PILOT |

Status	Criticality	Timeframe	Approach	Owner
☑ Open	☑ High	☑ Near	☑ Accept	All Owners ⌄
☑ Closed	☑ Medium	☑ Mid	☑ Research	**Team**
	☑ Low	☑ Far	☑ Mitigate	All Teams ⌄
			☑ Watch	**Category**
				All Categories ⌄
				Group
				Everyone ⌄

3) Sort Risks: ⦿ Descending ○ Ascending ○ RID   [Search]

Risk Counts	Approved	Draft	Modified
Total	8	1	1
Search Total:	0	0	0

Approved Risks (Click on risk title to view/modify risk details)

Risk ID - Title-

Risk Statement   Owner   Status

Risk Total   Category   Timeframe

Approved Risks (Click on risk title to view/modify risk details)

	Risk ID - Title- Risk Statement	Owner	Status
Risk Total		Category	Timeframe
L/C		Team	Approach

H

PILOT-1-<u>Distress due to Internal Contamination</u>

Given that objects (contamination) may impact the inducer/impeller, there is a posibility that leading edge turbine fractures damage thus reducing the pump margin and cavitations will occur.

Total: 20

L/C: 5/4

Owner	Status
Moore-Hartley, Pat	Open
Materials	Far
Engineering	Watch

H

PILOT-2-<u>High Cycle Fatigue</u>

Given the vibrations from various sources, there is a possibility that induced high cycle fatigue in the bearing races, rolling elements, and cage will occur.

Total: 16

L/C: 4/4

Owner	Status
Coker, Cynthia	Open
Setup	Mid
Testing	Research

M

PILOT-3-<u>Premature Engine Shutdown</u>

Given the several conditions exist which could lead to a premature shutdown of a main engine, there is a possibility where an unsuccessful recoverable abort will occur.

Total: 12

L/C: 3/4

Owner	Status
Mullane, Dan	Open
Reliability	Far
S&MA	Research

M

PILOT-4-<u>High Pressure Fuel Turbopump (HPFTP) housing external leak/rupture.</u>

Given the result that defects introduced through manufacturing or handling damage may occur, there is a possibility that reduced rotor part strength or life will occur.

Total: 12

L/C: 4/3

Owner	Status
Powell, William	Open
Quality	Near
S&MA	Mitigate

M   PILOT-5-High Pressure Oxygen Tubopump Turbine Blade Failure

Given the failure of a turbine blade at high RPMs can lead Spurgeon,   Open
to turbine fragmentation, there is a possibility of loss of   Jennifer
Total: 8   containment will occur.

L/C: 2/4   Setup   Far

                                                 Testing   Research

---

M   PILOT-6-Loss of Thrust

Given the cryogenic temperature of Hydrogen (~ -420 F)   Suttle, Madelyn   Open
in the fuel ducts and pumps, there is a possibility that
tehy can condense and liquify the Nitrogen in the aft
Total: 8   compartment on the uninsulated components or on other   Reliability   Near
comonents where there are faults in their insulation will
occur.

L/C: 2/4   S&MA   Research

M   PILOT-8-Failure to complete ISSRC 2008 presentation on time.   [Mod(s) Exist]

Given that current work load tasks are increasing,   Johnson, Paul   Open
there is a possibility that not completing the ISSRC
Total: 8   2008 on time will occur.   Schedule   Near

L/C: 2/4   Management   Mitigate

L   PILOT-7-Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire

Given that miscalculations in the engine balance or   Grubbs, Rodney   Open
turbopump performanc, there is a possibility that an
incorrect installation (before flight or during
Total: 6   refurbishments) of an oversized discharge coolant orifice   Drawings   Near
and overspeeding of the LPFTP will occur.

L/C: 2/3   Engineering   Mitigate

Draft Risks (Click on risk title to view/modify risk details)

	Risk ID - Title-		
	Risk Statement	Owner	Status
Risk Total		Category	Timeframe
L/C		Team	Approach

L

PILOT-7-Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire

Total: 6	Given that miscalculations in the engine balance or turbopump performanc, there is a possibility that an incorrect installation (before flight or during refurbishments) of an oversized discharge coolant orifice and overspeeding of the LPFTP will occur.	Grubbs, Rodney Open
		Drawings Near
L/C: 2/3		Engineering Mitigate

Draft Risks (Click on risk title to view/modify risk details)

	Risk ID - Title-		
	Risk Statement	Owner	Status
Risk Total		Category	Timeframe
L/C		Team	Approach

M

PILOT-D-1-Minimum time between arrival and departure flights.   Delete

Total: 6	Given that there is minimum time between arrival and departure flights, there is a possibility that any delay in an arrival flight a missed connection flight will occur.	Johnson, Paul Open
		Safety Near
L/C: 2/3		Management Watch

Submitted By: Johnson, Paul

Modified Risks (Click on risk title to view/modify risk details)

	Risk ID - Title-		
	Risk Statement	Owner	Status
Risk Total		Category	Timeframe
L/C		Team	Approach

M

PILOT-M-8-(1)-Failure to complete ISSRC 2008 presentation on time.   Delete

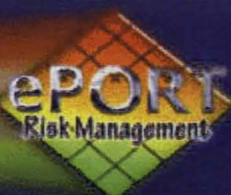|		
Total: 8	Given that current work load tasks are increasing, there is a possibility that not completing the ISSRC 2008 on time will occur.	Johnson, Paul Open
		Schedule Near
L/C: 2/4		Management Mitigate

Submitted By: Johnson, Paul

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PILOT ▼

- ◘ **Message Center**
- ◘ **Profile**
- ◘ **Risks**
  - ◘ **Add**
  - ◘ **Index**
  - ◘ ☑ **Status**
  - ◘ **5x5 Grid**
  - ◘ **Definitions**
- ◘ **Problems**
- ◘ **Reports**
- ◘ **Help**
- ◘ **Setup**
- ◘ **Sign Out**

Risks For PILOT

H (2)   **M** (5)   **L** (1)

Risk Status

Criticality L/C	Risk ID - Title / Risk Plan	Approach
H 5/4	PILOT-1-Distress due to Internal Contamination The use of materials, design configurations, etc., which generate contamination shall be minimized. Cored passages where either the coring material or the casting material can generate or become contamination sources, will be verified as free from contamination by suitable NDT techniques. All drilled or bored passes shall be deburred. A Contamination Control Plan will be provided.	Watch
H 4/4	PILOT-2-High Cycle Fatigue Control Provisions / ReferencesVerification: - Turbine airfoil durability analyses have been conducted to verify that the airfoils have infinite HCF life (REF: DVS-30, Para. 4.1.2.5). - The design will comply with additional specific vibratory criteria given in the ICD (REF: CP11372, Para 6.3.1). - Computational Fluid Dynamics (CFD) analyses will be performed to reduce flowpath perturbations. These analyses will be verified through water flow visualization and air flow substantiation tests (REF: DVS-30, Para's. 4.1.2.4, 4.1.2.6, 4.1.2.11, 4.1.3.2.5.1 and 4.1.3.2.5.2). - Rotor Dynamics Analysis verification shall be considered complete when the specified analyses have been completed, when it has been established that the worst operating conditions have been considered, and when the verifications tests listed in tables on pages 41 and 42 of DVS-30 have been met (REF: DVS-30, Para. 4.1.2.10). - Analyses will be verified through detail part and subassembly tests (REF: DVS-30, Para.'s 4.1.4.1.8.2 and 4.1.4.2.4.1).	Research
M 3/4	PILOT-3-Premature Engine Shutdown - Redline limit inhibit is documented in the integration hazard analysis. - Engines and major components are green run accented at a thrust profile which incudes 50 seconds at 100%. Develop a test plan to assest all	Research

4.1.3.2.5.2). - Rotor Dynamics Analysis verification shall be considered complete when the specified analyses have been completed, when it has been established that the worst operating conditions have been considered, and when the verifications tests listed in tables on pages 41 and 42 of DVS-30 have been met (REF: DVS-30, Para. 4.1.2.10). - Analyses will be verified through detail part and subassembly tests (REF: DVS-30, Para.'s 4.1.4.1.8.2 and 4.1.4.2.4.1).

M

3/4

PILOT-3-Premature Engine Shutdown   Research

- Redline limit inhibit is documented in the integration hazard analysis. - Engines and major components are green run accepted at a thrust profile which incudes 50 seconds at 109%. - Develop a test plan to assest all command input failure scenerios.

M

4/3

PILOT-4-High Pressure Fuel Turbopump (HPFTP) housing external leak/rupture.   Mitigate

P&W Engineering Source Approval for manufacturing processes & materials in manned rocket programs is a system established by Engineering for the control of certain parts, materials and processes where characteristics vital to the performance or integrity of the parts, materials or processes cannot be completely defined in a manner suitable for inspection purposes and must therefore be assured by procurement from sources which have demonstrated, to the satisfaction of Engineering and QA, the ability to produce the necessary characteristics. REF: PWA 371 Engineering Source Approval for Manufacturing Processes & Materials in Manned Rocket Programs.

M

2/4

PILOT-5-High Pressure Oxygen Tubopump Turbine Blade Failure   Research

Turbine airfoil durability analyses needs be be conducted to verify that the airfoils have infinite life.

M

2/4

PILOT-6-Loss of Thrust   Research

No research plan provided.

M

2/4

PILOT-8-Failure to complete ISSRC 2008 presentation on time.   Mitigate

Work diligently to ensure ISSRC 2008 presentation is completed and submitted to management for final approval.
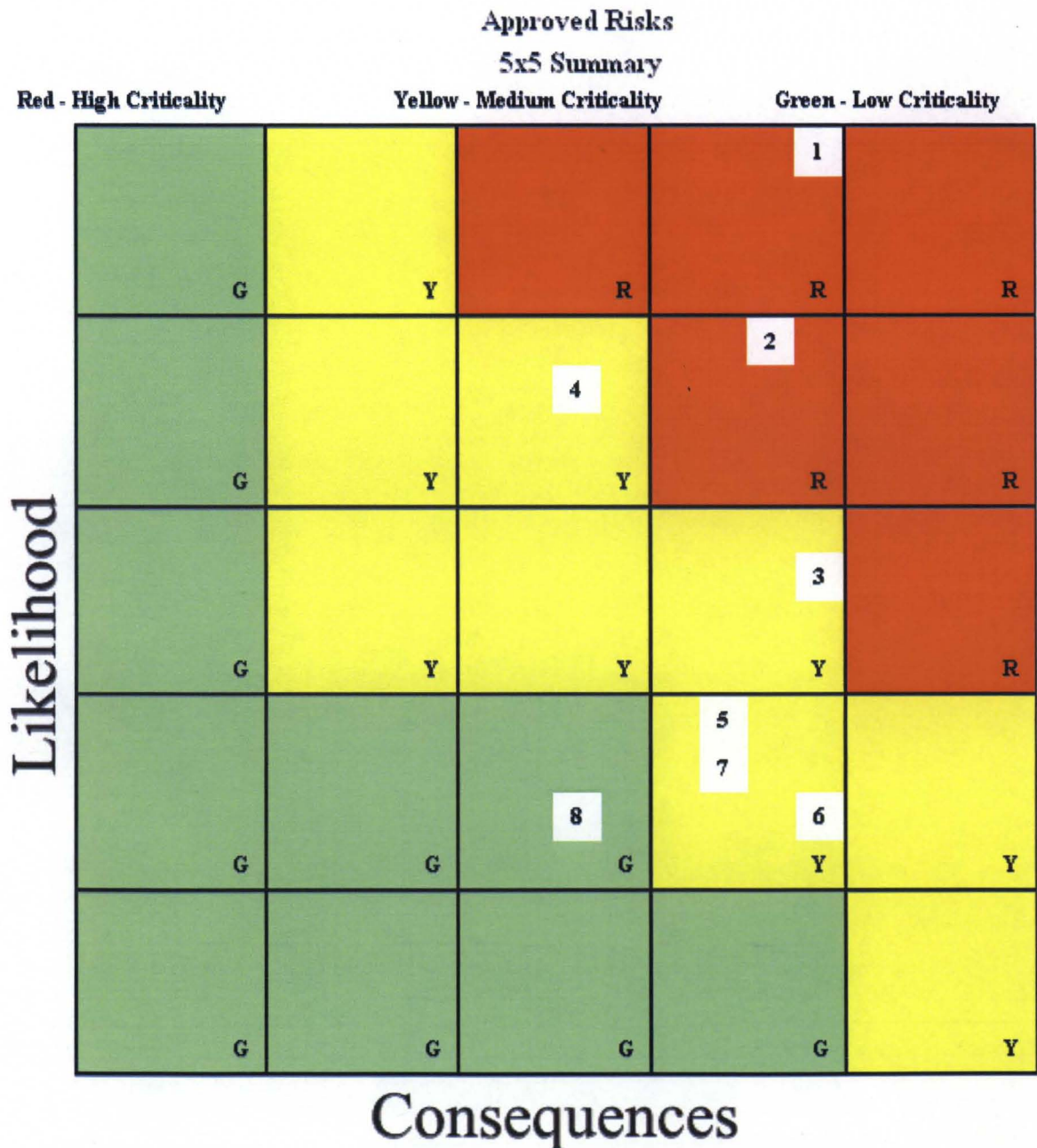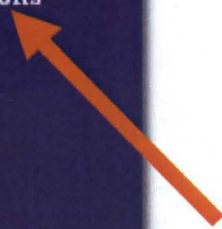

L

2/3

PILOT-7-Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire   Mitigate

Review drawings and sizing and installations of the F7 orrifice and adjust per specifications.

- Message Center
- Profile
- Risks
  - Add
  - Index
  - Status
  - ☑ 5x5 Grid
  - Definitions
- Problems
- Reports
- Help
- Setup
- Sign Out

Approved Risks

5x5 Summary

Red - High Criticality   Yellow - Medium Criticality   Green - Low Criticality

			1	
G	Y	R	R	R
		4	2	
G	Y	Y	R	R
			3	
G	Y	Y	Y	R
			5 7	6
G	G	8 G	Y	Y
G	G	G	G	Y

Likelihood

Consequences

	G	G	G	G	Y

Consequences

Trend	Rank From	Rank To	Risk ID	Approach-Title
New	-	1	PILOT-1	W- Distress due to Internal Contamination
New	-	2	PILOT-2	R- High Cycle Fatigue
New	-	3	PILOT-3	R- Premature Engine Shutdown
New	-	4	PILOT-4	M- High Pressure Fuel Turbopump (HPFTP) housing external leak/rupture.
New	-	5	PILOT-5	R- High Pressure Oxygen Tubopump Turbine Blade Failure
New	-	6	PILOT-6	R- Loss of Thrust
New	-	7	PILOT-8	M- Failure to complete ISSRC 2008 presentation on time.
New	-	8	PILOT-7	M- Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire

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Risks For PILOT

H (0)   **M** (0)   **L** (0)

PILOT

- **Message Center**
- **Profile**
- **Risks**
- **Problems**
- **Reports**
  - ☑ **Risks**
  - **Problems**
  - **General**
- **Help**
- **Setup**
- **Sign Out**

Select report template then select the criteria.

Select Report Template: Index

1) Select Intiative(s):

PILOT

2) Select the Criteria:

Status	Criticality	Timeframe	Approach
☑ Open	☑ High	☑ Near	☑ Accept
☑ Closed	☑ Medium	☑ Mid	☑ Research
	☑ Low	☑ Far	☑ Mitigate
			☑ Watch

Owner

All Owners

Team

All Teams

As Of Date: 3/26/2008   **Format:** ◉ PDF ○ Excel

3) Sort Risks: ◉ Descending ○ Ascending ○ RID   Search

Cost   Schedule   Safety   <u>Technical</u>

Development, Level of Technology Readiness, Work Breakdown Structure (WBS), Refunding Profile, Manpower Availability Initial Design Review (IDR), Preliminary Design Review (PDR), Material Readiness Review (MRR), Critical Design Review (CDR), Manufacturing Due Dates, Delivery Dates, - Hazard Analysis, Failure Modes and Effects Analysis (FMEA), Critical Item List (CIL), Reliability Requirements, Redundancy Requirements (Fault Tolerance) Industrial Safety, Anomalies (Testing, Manufacturing, Quality Control), Design, Material Availability, Personnel Expertise, etc…

Propulsion Inflight Liquid Oxygen Test

Risk Index Report

H (2)   M (5)   L (1)

Approved Risks

Criticality Risk Total L/C	Risk ID - Title Risk Statement	Owner Category Team	Status Timeframe Approach
H Total: 20	PILOT-1 - Distress due to Internal Contamination	Moore-Hartley, Pat	Open
	Given that objects (contamination) may impact the inducer/impeller, there is a posibility that leading edge turbine fractures damage thus reducing the pump margin and cavitations will occur.	Materials	Far
L/C: 5/4		Engineering	Watch
H Total: 16	PILOT-2 - High Cycle Fatigue	Coker, Cynthia	Open
	Given the vibrations from various sources, there is a possibility that induced high cycle fatigue in the bearing races, rolling elements, and cage will occur.	Setup	Mid
L/C: 4/4		Testing	Research
M Total: 12	PILOT-3 - Premature Engine Shutdown	Mullane, Dan	Open
	Given the several conditions exist which could lead to a premature shutdown of a main engine, there is a possibility where an unsuccessful recoverable abort will occur.	Reliability	Far
L/C: 3/4		S&MA	Research

M	PILOT-6 - Loss of Thrust	Suttle, Madelyn	Open
Total: 8	Given the cryogenic temperature of Hydrogen (~ -420 F) in the fuel ducts and pumps, there is a possibility that tehy can condense and liquify the Nitrogen in the aft compartment on the uninsulated components or on other comonents where there are faults in their insulation will occur.	Reliability	Near
L/C: 2/4		S&MA	Research
M	PILOT-8 - Failure to complete ISSRC 2008 presentation on time.	Johnson, Paul	Open
Total: 8	Given that current work load tasks are increasing, there is a possibility that not completing the ISSRC 2008 on time will occur.	Schedule	Near
L/C: 2/4		Management	Mitigate
L	PILOT-7 - Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire	Grubbs, Rodney	Open
Total: 6	Given that miscalculations in the engine balance or turbopump performanc, there is a possibility that an incorrect installation (before flight or during refurbishments) of an oversized discharge coolant orifice and overspeeding of the LPFTP will occur.	Drawings	Near
L/C: 2/3		Engineering	Mitigate

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Risk Management

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Good Afternoon, Paul!

PILOT ⌄

- ◘ **Message Center**
- ◘ **Profile**
- ◘ **Risks**
- ◘ **Problems**
- ◘ **Reports**
  - ◘ ☑ **Risks**
  - ◘ **Problems**
  - ◘ **General**
- ◘ **Help**
- ◘ **Setup**
- ◘ **Sign Out**

Risks For PILOT

H (2)   **M** (5)   **L** (1)

Select report template then select the criteria.

Select Report Template: Index ⌄

1) Select Intiative(s):   **2) Select the Criteria:**

PILOT

Status	Criticality	Timeframe	Approach
☑ Open	☑ High	☑ Near	☑ Accept
☑ Closed	☑ Medium	☑ Mid	☑ Research
	☑ Low	☑ Far	☑ Mitigate
			☑ Watch

Owner
| All Owners ^ |
| Coker, Cynthia |
| Grubbs, Rodney |
| Johnson, Paul ⌄ |

Team
| All Teams ^ |
| Engineering |
| Management |
| S&MA ⌄ |

Category
| All Categories ^ |
| Drawings |
| Materials |
| Quality ⌄ |

As Of Date: 4/14/2008   **Format:** ○ PDF ⊙ Excel

3) Sort Risks: ⊙ Descending ○ Ascending ○ RID   Search

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z AA AB AC AD AE AF AG AH AI AJ AK AL AM AN AO

Propulsion Inflight Liquid Oxygen Test

Risk Index Report

| H (2) | M (5) | L (1) |

Approved Risks

Criticality Risk Total L/C	Risk ID - Title Risk Statement	Owner Category Team	Status Timeframe Approach
H Total: 20 L/C: 5/4	PILOT-1 - Distress due to Internal Contamination Given that objects (contamination) may impact the inducer/impeller, there is a	Moore-Hartley, Pat Materials Engineering	Open Far Watch
H Total: 16 L/C: 4/4	PILOT-2 - High Cycle Fatigue Given the vibrations from various sources, there is a possibility that induced high	Coker, Cynthia Setup Testing	Open Mid Research
M Total: 12 L/C: 3/4	PILOT-3 - Premature Engine Shutdown Given the several conditions exist which could lead to a premature shutdown of a	Mullane, Dan Reliability S&MA	Open Far Research
M Total: 12 L/C: 4/3	PILOT-4 - High Pressure Fuel Turbopump (HPFTP) housing external leak/rupture. Given the result that defects introduced through manufacturing or handling damage	Powell, William Quality S&MA	Open Near Mitigate
M Total: 8 L/C: 2/4	PILOT-5 - High Pressure Oxygen Tubopump Turbine Blade Failure Given the failure of a turbine blade at high RPMs can lead to turbine fragmentation,	Spurgeon, Jennifer Setup Testing	Open Far Research

RiskIndex

A	E	F	K L	M	N	O	P	R S	T	U W	Y	AB	AD	AC AH AM	AN	AO
		L/C: 4/4						Testing				Research				
	N				PILOT-3 - Premature Engine Shutdown			Mullane, Dan				Open				
		Total: 12			Given the several conditions exist which could lead to a premature shutdown of a			Reliability				Far				
		L/C: 3/4						S&MA				Research				
	N				PILOT-4 - High Pressure Fuel Turbopump (HPFTP) housing external leak/rupture.			Powell, William				Open				
		Total: 12			Given the result that defects introduced through manufacturing or handling damage			Quality				Near				
		L/C: 4/3						S&MA				Mitigate				
	N				PILOT-5 - High Pressure Oxygen Tubopump Turbine Blade Failure			Spurgeon, Jennifer				Open				
		Total: 8			Given the failure of a turbine blade at high RPMs can lead to turbine fragmentation,			Setup				Far				
		L/C: 2/4						Testing				Research				
	N				PILOT-6 - Loss of Thrust			Suttle, Madelyn				Open				
		Total: 8			Given the cryogenic temperature of Hydrogen (~ -420 F) in the fuel ducts and pumps,			Reliability				Near				
		L/C: 2/4						S&MA				Research				
	N				PILOT-8 - Failure to complete ISSRC 2008 presentation on time.			Johnson, Paul				Open				
		Total: 8			Given that current work load tasks are increasing, there is a possibility that not			Schedule				Near				
		L/C: 2/4						Management				Mitigate				
	L				PILOT-7 - Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire			Grubbs, Rodney				Open				
		Total: 6			Given that miscalculations in the engine balance or turbopump performanc, there is a			Drawings				Near				
		L/C: 2/3						Engineering				Mitigate				

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ePORT
Risk Management

Good Afternoon, Paul!

PILOT ▾

◘ Message Center
◘ Profile
◘ Risks
◘ Problems
◘ Reports
  ◘ Risks
  ◘ ☑ Problems
  ◘ General
◘ Help
◘ Setup
◘ Sign Out

Problems For PILOT

H (0)   M (0)   L (0)

Select report template then select the criteria.

Select Report Template: Index ▾

1) Select Intiative(s):

PILOT

2) Select the Criteria:

Status	Criticality	Timeframe
☑ Open	☑ High	☑ Near
☑ Closed	☑ Medium	☑ Mid
	☑ Low	☑ Far

Owner

All Owners

Team

All Teams

As Of Date: 3/26/2008   **Format:** ⦿ PDF ◯ Excel

3) Sort Problems: ⦿ Descending ◯ Ascending ◯ PID   [Search]

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PILOT

- ◘ Message Center
- ◘ Profile
- ◘ Risks
- ◘ Problems
- ◘ Reports
  - ◘ Risks
  - ◘ Problems
  - ◘ ☑ General
- ◘ Help
- ◘ Setup
- ◘ Sign Out

General For PILOT

H (0)   M (0)   L (0)

Select report template then select the criteria.

Select Report Template: Team Contact List ▼

1) Select Intiative(s):

PILOT

2) Select the Criteria:

Format: ⦿ PDF   ◯ Excel

Search

January 10,

National Aeronautics and
Space Administration

George C Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

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User's Guide

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Good Afternoon, Paul!

PILOT

- Message Center
- Profile
- Risks
- Problems
- Reports
- Help
- Setup
  - My Preferences
  - ☑ Initiative Mgr
    - Members
    - Grp/Tms/Cat
    - Messages
    - Risk Defin
    - Problem Defin
    - Risk Transfer
    - Manage Init
- Sign Out

Initiative Manager Quick Look

Risk Counts
- High:
- Med:
- Low:

Problems Counts
- High:
- Med:
- Low:

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PILOT

- ◼ Message Center
- ◼ Profile
- ◼ Risks
- ◼ Problems
- ◼ Reports
- ◼ Help
- ◼ Setup
  - ◼ My Preferences
  - ◼ Initiative Mgr
    - ◼ Members
    - ◼ Grp/Tms/Cat
    - ◼ Messages
    - ◼ Risk Defin
    - ◼ Problem Defin
    - ◼ ☑ Risk Transfe
    - ◼ Manage Init
- ◼ Sign Out

Risk Transfer for PILOT

NOTE: Transferring a risk should only be done after much consideration. This step is not reversible. The source risk will be closed and will not be able to be modified after the transfer. If the risk must be transferred follow the steps below.

Step 1) Select source initiative

Select a Source Initiative ▼

Good Afternoon, Paul!

PILOT

- Message Center
- Profile
- Risks
- Problems
- Reports
- Help
- Setup
  - My Preferences
  - Initiative Mgr
    - Members
    - Grp/Tms/Cat
    - Messages
    - Risk Defin
    - Problem Defin
    - ☑ Risk Transfe
    - Manage Init
- Sign Out

Risk Transfer for PILOT

NOTE: Transferring a risk should only be done after much consideration. This step is not reversible. The source risk will be closed and will not be able to be modified after the transfer. If the risk must be transferred follow the steps below.

Step 1) Select source initiative

PILOT

Step 2) Select target initiative

Sample Proj

Step 3) Select the risk to be transferred.

PILOT-6-Loss of Thrust

Step 4) Select a new owner, new category and new team for the risk

Current Risk Owner:	Target Initiative Owners:
Suttle, Madelyn	Select a Owner
Current Risk Category:	Target Initiative Categories:
Reliability	Select a Category
Current Risk Team:	Target Initiative Teams:
S&MA	Select a Team

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ePORT Risk Management

Good Afternoon, Paul!

PILOT

- **Message Center**
- **Profile**
- **Risks**
- **Problems**
- **Reports**
- **Help**
- **Setup**
  - **My Preferences**
  - **Initiative Mgr**
    - **Members**
    - **Grp/Tms/Cat**
    - **Messages**
    - **Risk Defin**
    - **Problem Defin**
    - **Risk Transfer**
    - ☑ **Manage Init**
- **Sign Out**

Initiative Management for PILOT

NOTE: Risk Managers can add initiatives to a level directly below the current assigned initiative. Only an initiative created by a Risk Manager and that does not have any approved risks can be deleted.

Initiative Hierarchy

PILOT

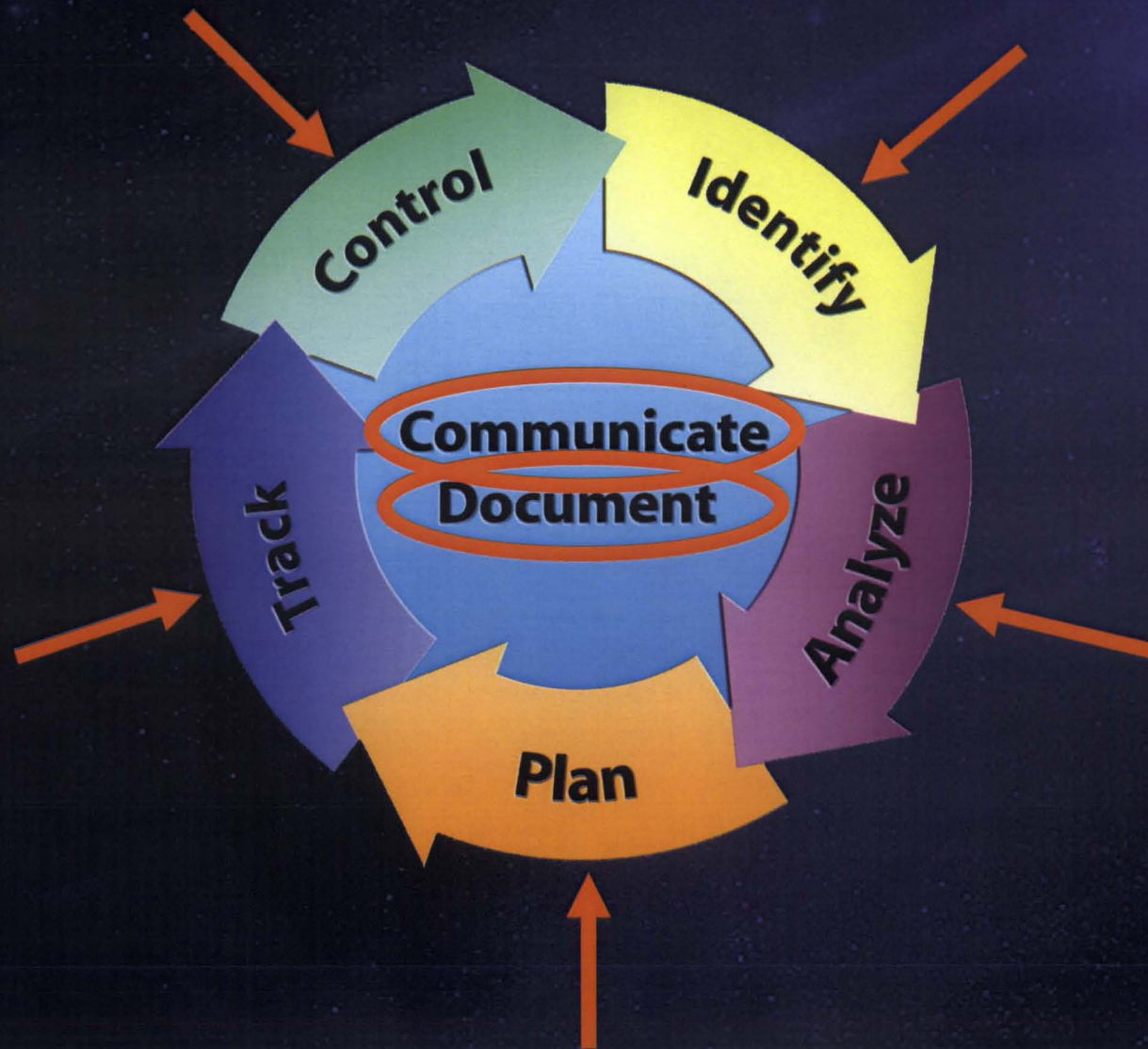| Add Initiative Form		
Initiative Information		
Center: Select Center ▾		
Initiative Name:		Acronym:
		Submit

Delete Initiative	
Initiative: PILOT	Submit
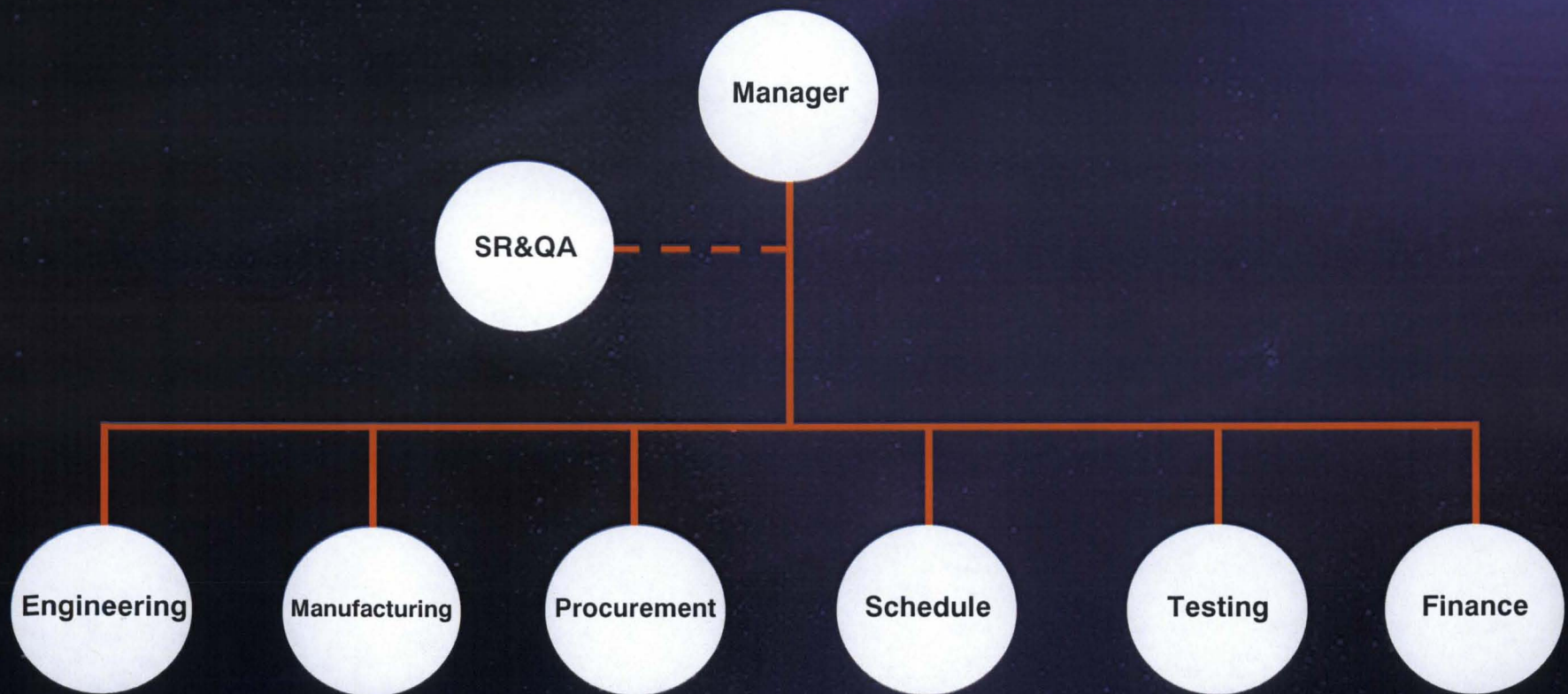
RESPONSIBILITY

COMMUNICATION
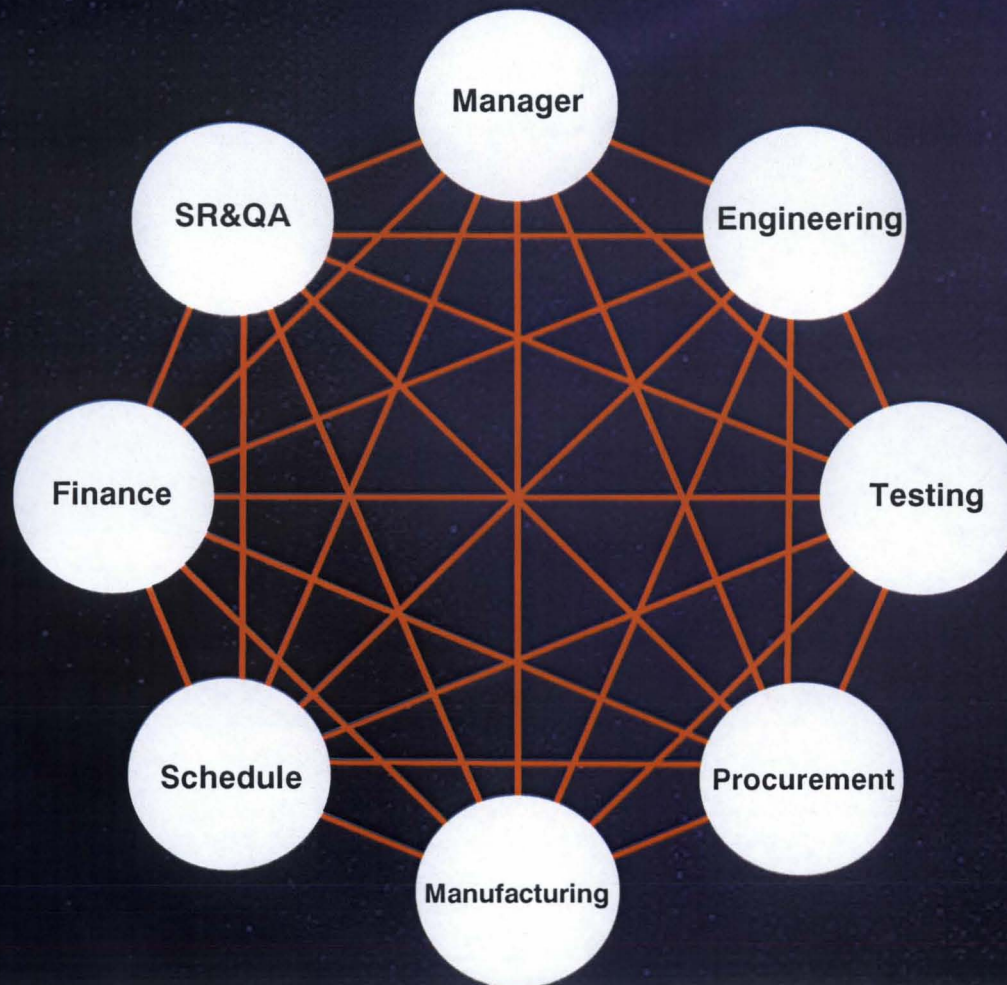
THINGS TO THINK ABOUT

INDICATORS
(What to look for)

◆ **Trend Analysis**
  - Setting Upper / Lower Trigger Indicators
  - http://www.itl.nist.gov/div898/handbook/pmc/section3/pmc32.htm

◆ **Statistical Process Control (SPC)**
  - Out of Control Processes / Out of Control Indicators
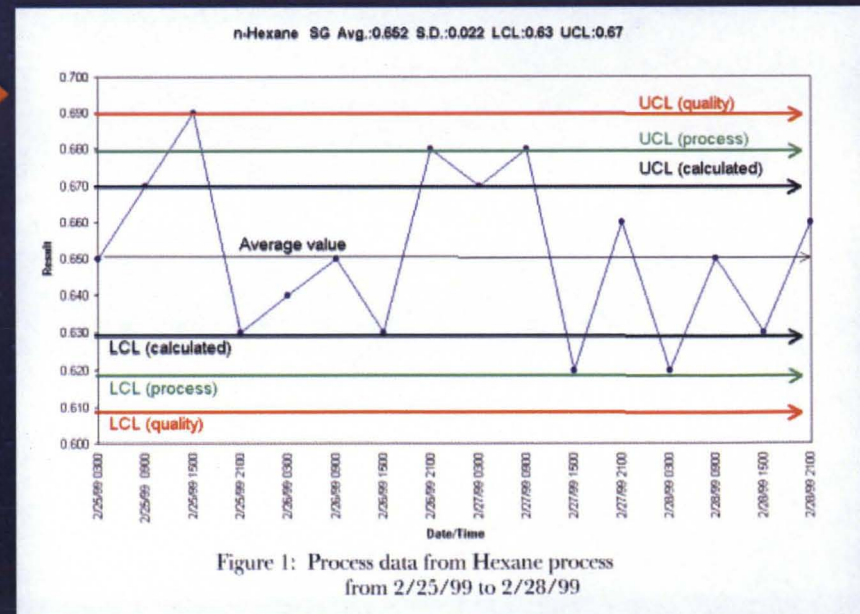 - http://www.cheresources.com/spczz.shtml

◆ **Learning from Past Mistakes**
  - Record but not read and understand

◆ **SSME**
  - In Family / Out of Family

◆ **Private Mig Pilot**
  - By the book he was right.

n-Hexane SG Avg.:0.652 S.D.:0.022 LCL:0.63 UCL:0.67

Figure 1: Process data from Hexane process from 2/25/99 to 2/28/99

Continuous Risk Management Process Flow

NASA · **S&MA**

Legend:
- Feedback Loop
- Documentation Loop
- Process Loop

Individual Uncertainties

Group/Team Uncertainties

Program/Project Data

A. Risk Statement Definition
Given the *Condition*, there is a possibility that this *Consequence* will occur.

Risk Database
B. Program/Project Risks Lists

----

1. Identify

2. Analyze

A. Risk Attributes
- Likelihood
- Consequence
- Timeframe
as determined by Program/Project

Risk Database
B. Create Master Risks Lists

C. Classify & Prioritize Risks Lists

Concern	Concern
Risk	Risk

Resources

Program/Project Goals & Constraints

3. Plan

A. Assign Responsibility & Plan Approach

Watch	Accept	Mitigate

Set Scope & Success Metrics

B. Develop Action Plans

C. Risk & Mitigation Plan Metric

Program/Project Data

Resources

4. Track

A. Status Reports Risk & Mitigation Plans

B. Collect Metrics

Set Triggers	Strategize Mitigation
Set Thresholds	Create Mitigation Plans
Watch Trends	Track Mitigation Plans
Track Risk Attributes	Report Risk Status

5. Control

Program/Project Data

A. Analyze Risk Reports and determine the next step:
- Continue current plan
- Update/Correct Current Plan
- Close the risk
- Invoke a risk Contingency Plan
Then make risk decisions known

B. Inform Decision Makers by:
- Updating risk list/database
- Keep Program/Project members informed

6. Communicate & Document

Risk Database
A. Create/Update Risk List
B. Create/Update Risks Matrix
C. Create/Update Risk Metrics

Continuous Risk Management Summary Card

S&MA

| Continuous Risk Management (CRM) Definitions | **CONTINUOUS RISK MANAGEMENT (CRM)** – A management practice with processes, methods, and tools for managing risks in a program or project.
RISK – is characterized by the combination of the **Likelihood/Probability** that a program or project will experience an undesired event (some examples include a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technological breakthrough or mission success criteria) and the **consequences, impact, or severity** of the undesired event, were it to occur. | **LIKELIHOOD** – the probability that the risk will occur.
CONSEQUENCE – the loss or effect on the program/project if the risk occurs.
TIMEFRAME – the period when action must be taken to handle the risk mitigation plan.
COST – a program/project cost issue that directly/indirectly impacts the program/project budget.
SAFETY – a program/project safety issue that directly impacts the program/project.
SCHEDULE – a program/project schedule issue that directly impacts the program/project.
TECHNICAL - a program/project technical issue that directly impacts the program/project. |

TIMEFRAME

The time period to mitigate the risk.

- Near – within the next 3 months
- Mid-Term – between 4 - 8 months
- Far – beyond 8 months

LEGEND

(red)	High – Implement new processes or change baseline plans
(yellow)	Moderate – Aggressively manage; consider alternative process
(green)	Low – Track and Monitor

LIKELIHOOD

What is the likelihood the situation or circumstance will happen?

Level	Probability	... or the current process ...
5	Very High	cannot prevent this event, no alternative approaches or processes are available.
4	High	cannot prevent this event, but a different approach or process might.
3	Moderate	may prevent this event, but additional actions will be required.
2	Low	is usually sufficient to prevent this type of event.
1	Very Low	is sufficient to prevent this event.

RISK MATRIX

LIKELIHOOD (vertical axis: 5, 4, 3, 2, 1) vs CONSEQUENCES (horizontal axis: 1, 2, 3, 4, 5)

Sample data - What is the Consequence (Cost, Schedule, Safety, or Technical) of this Risk? – Sample data

Level	1	2	3	4	5
Cost	Minimal or no impact	Budget Increase < 5%	Budget Increase > 5%	Budget Increase >10%	Budget Increase >15%
Schedule	Minimal or no impact	Additional activities required. Able to meet date.	Key Program Milestone Slip<=1 Month	Key Program Milestone Slip>1 Month, or Program Critical Path impacted	Cannot achieve Major Program milestone
Technical	Minimal or no impact	Moderate reduction, same approached retained	Moderate reduction but alternatives available	Major reduction but alternatives available	Unacceptable, no alternatives exist
Safety	•No Safety and Health Plan Violation •No adverse hazard or reliability change •Full regulatory compliance	•Documented CIL •Change in hazard controls but no increase in PRA •Minor violation of Federal or State regulations •<10% decrease in reliability	•CIL without acceptance rationale •Change in hazard controls but with increase in PRA •Violation of Federal or State regulations •10-20% decrease in reliability	•Major but temporary injury •Potential damage to assets •Multiple violations of Federal or State regulations •>20% decrease in reliability	•Potential for permanent injury or death •Loss of Critical assets •Willful or major violations of Federal or State regulations

Program/Project Risk Definitions

RISK: A Risk is characterized by the <u>combination</u> of the "probability" that the Program/Project will experience an undesired event (cost, schedule, safety or technical) and the "consequences, impact or severity" of the undesired event, were it to occur. All Risks must be actionable.

RISK MANAGEMENT: Risk Management (RM) is a <u>continuous</u>, iterative process to manage Risk in order to achieve mission success. RM uses a structured team and with all stakeholders. It should be a key element and an integral part of normal Program/Project management and engineering processes.

1 IDENTIFY

A. Early identification and management methods include: budgetary reviews, expert interviews, trend analysis of metrics, comparison of goals and plans, Program/Project Manager's analysis and reviews, engineering analysis and trade studies.

B. Key areas to assess include: budget, requirements, technology, management, engineering, supportability, logistics and maintenance, operations, safety, programmatic, and political.

C. Information Sources: metrics, historical data, resources, suppliers, plans, proposed changes, test results. Is consideration given to all sources for identifying Risks?

2 ANALYZE

A. Perform detailed engineering analysis including trend and sensitivity analysis, as appropriate.

B. Determine the likelihood of the event.

C. Determine the item's consequences:

    1. Safety includes: impacts to health or safety of personnel/crew or damage to property.

    2. Performance (Mission Success) includes: technical performance; operations; requirements issues; logistics, maintenance and supportability; environmental issues; or generally affects mission objectives.

    3. Cost includes: Program/Project budget or resources.

    4. Schedule includes: impacts to project milestones or schedule.

D. Need to integrate like issue/risks together to analyze cumulative effects ("find similar threads").

E. Need to identify all groups affected by this risk (all affected parties).

F. Plot the Risk on a Risk Matrix.

G. Enter the Risk and analysis data into the Risk database.

3 PLAN

A. Based on analysis (e.g., trade studies, etc.) identify the best Risk Mitigation Plan.

B. Develop the Risk Mitigation Plan to reduce likelihood of occurrence and/or reduce severity of consequences by either redesigning, modifying requirements, acquiring additional resources, augmenting test or verification, operational workarounds, or renegotiating with stakeholders. Notify all affected parties with changes or status updates and link them in the database as an affected organization/stakeholder.

C. Develop contingency plans/fallback plans.

D. Recommend escalating Risk to higher board/panel.

E. Are the mitigation plan(s) adequate?

F. When a Risk cannot be efficiently reduced/mitigated any further, consider accepting the Risk.

4 TRACK

A. Watch and track the Risk Attributes and Mitigation Plans. Are plans being performed in a timely manner and is the Mitigation Plan working or do you need to go to the fallback plan?

B. Update Risk database as related data are acquired, compiled, analyzed, and/or reported.

C. Use tracking reports to communicate information (quantitative and/or qualitative) required for effective control decisions.

D. Risk tracking should include use of metrics.

5 CONTROL

A. Use processes in which decisions are made based on the data presented in the tracking reports. This ensures that the Risk is continually and effectively managed.

B. Decisions are based on current information as well as experience and must adapt to any changing conditions.

C. Risk decisions and current mechanisms should be integrated with standard Program/Project management practices.

D. Utilize tracking data to determine how to proceed with Risk (close, continue tracking and execution the current plan, re-plan, or invoke a contingency plan)

E. Set trigger points or thresholds for watched risks – when Risk needs to be re-evaluated.

6 COMMUNICATE AND DOCUMENT

A. Provide information and feedback to the Program/Project on Risk activities, risk status, and potential new Risks.

B. Ensure the documentation and visibility of Risk information for better management and integration.

C. Enter all Risk data including current status and mitigation plans into the Risk database.

National Aeronautics and
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MARSHALL SPACE FLIGHT CENTER
Continuous Risk Management (CRM) Training Processes and Solutions

Continuous Risk Management Guidebook

WRAP-UP

- ◆ **Quote**

- ◆ **ePORT History**

- ◆ **Continuous Risk Management Process**

- ◆ **ePORT - Project: PILOT**

- ◆ **Things To Think About**

- ◆ **Q&A**

THANK
YOU